

Standards Applicable to Owners and Operators of
Hazardous Waste Treatment, Storage, and Disposal
Facilities Under RCRA (Resource Conservation and
Recovery Act), Subtitle C, Section 3004

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BACKGROUND DOCUMENT

STANDARDS APPLICABLE TO OWNERS AND OPERATORS
OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL
FACILITIES UNDER RCRA, SUBTITLE C, SECTION 3004

Incineration Standards
(40 CFR 264 and 265, Subpart O)

This document (ms. 1941.16) provides background information
and support for EPA's hazardous waste regulations

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CONTENTS

I.	<u>INTRODUCTION AND BACKGROUND</u>	1
A.	Content of the Background Document.....	1
B.	Mandate for the Regulation.....	4
C.	Key Definitions.....	5
II.	<u>NEED TO REGULATE INCINERATION</u>	11
A.	Potential Damage Cases from Unregulated Incineration.....	11
B.	Damage Incidents from Improper Incineration.....	15
C.	Other Federal Regulations.....	16
1.	Clean Air Act.....	16
2.	Toxic Substances Control Act.....	19
D.	State Regulations.....	20
III.	<u>SUMMARY OF PROPOSED REGULATIONS</u>	22
IV.	<u>INTERIM STATUS STANDARDS</u>	25
A.	Introduction.....	25
B.	Basis for the Interim Status Standards.....	25
C.	Response to Comments on Interim Status Standards Promulgated on May 19, 1980, Including December 18, 1978 Proposal and Rationale for Interim Final ISS.....	30
D.	Comments/Response to Comments on Interim Final ISS.....	54
E.	Final ISS.....	63
V.	<u>CONCEPT OF BEST ENGINEERING JUDGEMENT (BEJ) IN GENERAL (PERMITTING) STANDARDS</u>	67
A.	Conceptual Approach to the Final Standards Incorporating BEJ.....	67

VI.	<u>RESPONSE TO COMMENTS/RATIONALE FOR THE FINAL STANDARDS</u>	75
A.	General Issues.....	75
B.	Exemption of Ignitable Waste.....	80
C.	Exemption for Trial Burns.....	83
D.	Destruction and Removal Efficiency (DRE).....	84
E.	Emissions of Halogens and Metals.....	107
F.	Particulate Emissions.....	117
G.	Operating Standards and Performance Monitoring...	124
H.	Operating Practices - Preheating of Incinerators.	142
I.	Operating Practices - Fugitive Emissions.....	143
J.	Operating Practices - Automatic Shutoff.....	146
K.	Trial Burns.....	159
L.	Waste Analysis.....	187
M.	Instrument Monitoring and Facility Inspections...	192
N.	Closure.....	197
	References.....	198
	Appendices.....	205

I. INTRODUCTION AND BACKGROUND

A. Content of the Background Document

This is one of a series of documents providing support and background information for regulations issued under Section 3004 of the Resource Conservation and Recovery Act of 1976. Each Background Document describes a regulation as originally proposed, summarizes and responds to comments received that relate to that original proposal, and indicates the Agency's rationale for final regulations.

On December 18, 1978, the Agency proposed standards for incineration of hazardous wastes (43 FR, at 59008). As a result of that proposal, extensive comments were received. The Agency issued a limited set of Interim Status standards on May 19, 1980, and responded to comments relevant to the Interim Status Standards. Those standards, Part 265, Subpart O Incineration, were issued as interim final standards, subject to comment. A limited number of comments were received on Subpart O; and are addressed in Section IV of this document. The final text of the Interim Status Standards is also presented in that section.

The Agency has now promulgated the General Standards for incinerators. These are the major technical requirements which provide the basis for issuing permits under Part 122 of the May 19, 1980 regulations. This background document summarizes the rationale for these standards, including response to the comments received on the proposed regulations.

As presented in this document, the Phase II regulations represent a shift in the conceptual approach to regulation of incineration. This shift was brought about largely due to broad objection by commenters to the proposed regulations. The proposed regulations were based on detailed design and operating requirements, along with relatively inflexible performance requirements. The final regulations rely on a basic performance standard, with facility-specific operating conditions set to attain the performance standard.

The basis for predicting compliance with the performance standard will usually be trial burns. These burns demonstrate operating conditions associated with achievement of the performance standard. These then become part of the permit and are the basis for continuous compliance monitoring. The engineering judgement of the permitting official is applied to define acceptable ranges in these operating conditions and in the composition of the wastes to which they may be applied. When sufficient alternative data are available to make these same determinations, the permitting official may waive the requirement for a trial burn.

In accord with the above approach and in response to other comments, the major changes in the final standards as compared to the proposed standards (December 18, 1978) are as follows:

- The proposed destruction efficiency of 99.99% has been replaced with a Destruction and Removal Efficiency (DRE) of 99.99% to define incinerator performance. Emissions can be measured at the point of release to the atmosphere, rather than in the combustion zone.
- Criteria have been specified which the Regional Administrator will use to designate Principal Organic Hazardous Constituents (POHC's) in the waste feed. EPA is also

proposing a set of criteria for determining combustion by-products formed in the incinerator.

- The uniform combustion efficiency performance standard based on CO₂ and CO concentrations in the stack gas has been dropped. Instead, CO limits are to be specified in the permit on a case-by-case basis and CO emissions are to be monitored during routine operation.
- The scrubber efficiency requirement of 99% removal of halogens has been limited to hydrogen chlorides. EPA is also proposing a procedure for setting emission limits for other halogens on a case-by-case basis.
- Trial burn requirements have been modified to allow waiver of trial burns if sufficient data is provided to demonstrate that the destruction efficiency requirements can be met and to identify the operating conditions necessary to achieve that performance.
- Waste analysis requirements have been specified to provide necessary information for the Regional Administrator's designation of the Principal Organic Hazardous Constituents, for his determination of DRE during a trial burn, and to ensure incinerator compliance with permit conditions during normal operation.
- Incineration of wastes which are hazardous due only to ignitability and which contain no constituents listed in 40 CFR Part 261 Appendix VIII, may be exempted from the incinerator regulations if approved by the Regional Administrator.
- Trial burns in an incinerator are regulated by §122.27(b)5 provisions for approval of trial burn plans.

The Agency believes that incineration of organic hazardous waste is the primary near term alternative to land disposal. Incineration can provide safe destruction of these organic wastes. Large volumes of liquid organic wastes not suitable for land disposal can be reduced to safe gaseous emissions and smaller amounts of residues (ash, scrubber sludges, etc). Incineration can minimize or eliminate the long term impact on human health and the environment of many hazardous wastes.

B. RCRA Mandate for the Regulation

The Congress of the United States, in Section 3004 of Subtitle C of the Resource Conservation and Recovery Act (RCRA) of 1976 (PL 94-580), required that the Administrator of the U.S. Environmental Protection Agency:

"...promulgate regulations establishing such performance standards, applicable to owners and operators of facilities for the treatment, storage, or disposal of hazardous waste identified or listed under this Subtitle, as may be necessary to protect human health and the environment. Such standards shall include, but need not be limited to, requirements respecting -...

- (3) treatment, storage, or disposal of all such wastes received by the facility pursuant to such operating methods, techniques, and practices as may be satisfactory to the Administrator;
- (4) the location, design, and construction of such hazardous waste treatment, disposal, or storage facilities;"
(emphasis added).

The term "treatment" is defined in Section 1004(34) of the Act to mean:

"...any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste or so as to render such waste non-hazardous, safer for transport, amenable for storage, or reduced in volume..."

One objective of incinerating hazardous waste is normally to change the physical form or chemical composition of the waste so as to render it non-hazardous. Incineration may also render the waste "safer for transport, amenable for recovery, amenable for storage, or reduced in volume." Therefore, incineration is a treatment process within the meaning of the Act, and the Agency is mandated to produce operating, location, design, and

construction regulations for the incineration of hazardous waste adequate to protect human health and the environment.

C. Key Definitions

The definitions given in Part 260 of the Regulations promulgated on May 19, 1980 (45 FR at 33066) should aid the reader in understanding this document. Some of those definitions are provided here for the readers' convenience. Changes from the definitions proposed on December 18, 1978 (43 FR at 59946) are discussed if they are relevant to the incineration standards.

1. "Facility" means all contiguous land, and structures, other appurtenances and improvements on the land, used for treating, storing, or disposing of hazardous waste. A facility may consist of several treatment, storage, or disposal operational units (e.g., one or more landfills, surface impoundments, or combinations of them).
2. "Fugitive Emissions" means air contaminant emissions from non-point emission sources, or other than those from stacks, ducts, or vents.
3. "Hazardous Waste" means hazardous waste as defined in §261.3 of the Regulations promulgated on May 19, 1980 (45 FR at 33119).
4. "Hazardous Combustion By-Products" are hazardous constituents formed in an incinerator from incomplete combustion of principal organic hazardous constituents. Hazardous combustion by-products or products of incomplete combustion (PIC's) will be designated by the Regional Administrator based on either:

- (1) the conduct of a trial burn (or review of alternate data) performed under §122.27 or §122.25, respectively.
 - (2) or based on the waste analysis performed in accordance with 264.13 and §122.25 or §122.27.
5. "Incinerator" means an enclosed device using high temperatures to combust hazardous waste organic constituents and where the products of combustion are emitted directly to the atmosphere with or without gas cleaning devices. Examples of incinerators are; rotary kiln, fluidized bed, liquid injection, molten salt, microwave discharge and infrared incinerators.

This definition has been modified from the proposed definition. Several commenters urged that energy recovery units (boilers or other facilities where the waste is used as fuel) should be excluded from coverage under these regulations since they were alleged to be more efficient and have higher destruction efficiencies than incinerators. Commenters also suggested that the proposed rules would inhibit use of wastes as a resource (fuel). These commenters suggested that the Agency should exempt incinerators and furnaces which utilize the heating value of wastes in order to promote resource recovery and help abate the energy crisis. An additional commenter urged similar treatment for furnaces which recover materials from hazardous wastes, for example, furnaces which thermally regenerate spent activated carbon.

The Agency has no evidence that boilers and other thermal devices which recover heat (or products) from hazardous wastes inherently have higher destruction efficiencies than incinerators designed to destruct hazardous wastes.

However, as defined in §261.6 of the regulations promulgated on May 19, 1980 (45 FR at 33120) hazardous waste which is beneficially used or reused or legitimately recycled or reclaimed is subject only to Subparts A, B, C, D, and E of Part 264. Thus, incineration of those wastes is not regulated at this time. It follows, then, that facilities burning these materials primarily to recover the energy value inherent in them, such as utility boilers and cement kilns, are not now considered hazardous waste facilities. Thus, boilers and cement kilns have been removed from the list of examples of incinerators. However, the Agency is further evaluating the "beneficial use" exemption of §261.6 including the need to regulate burning of hazardous waste in such facilities. The Agency expects to promulgate regulations to deal with specific types of hazardous waste recovery in the future if these investigations indicate a need to regulate such processes.

One commenter suggested that the definition be expanded to include facilities, other than those using flame combustion, that thermally degrade hazardous wastes. Examples suggested were molten salt incinerators

and pyrolysis units. Incinerator regulations which involve controls of air flow rate, temperatures, and so on, are designed specifically to relate to flame oxidation units. Other types of thermal treatment facilities, which operate on different principles, do not always meet and may not need to meet the conditions specified for flame combustion in order for them to be effective and protective of human health and the environment. Examples include those suggested by the commenter, as well as wet air oxidation (Zimmerman or Zimpro process) and microwave plasma destruction. The Agency is developing a separate set of regulations for these non-flame processes under Subpart P Thermal Treatment.

Another commenter felt that listing of examples of incinerators placed an unfair stigma on units of the same type (i.e., fluidized bed, kiln, etc) which do not burn hazardous wastes. While some uninformed people might attach such a stigma, the Agency is unable to see the significance of it. These rules do not cover any facility which does not burn hazardous wastes. It has been EPA's experience that as far as the public is concerned, it is the fact that the facility manages hazardous wastes, not the type of facility, which elicits the serious public concern about such facilities. The Agency believes that, for the sake of clarity, it is important to give examples of the types of equipment which met the definition.

One commenter urged that experimental incinerators should not be covered by the definition since, during experiments, it is not possible to guarantee that all of the criteria (temperatures, retention time, etc.) mandated in the proposed regulations will be met. This comment is discussed in Part VI of this document. These units are included in the definitions of incineration, however, conducting trial burns in incinerators is subject only to the more limited requirements of §122.27(b)

6. "Particulate matter" means any finely divided solid or liquid material, other than uncombined water, as measured by method 5 in 40 CFR §60.1 - Appendix A or an equivalent or alternative method. This definition is the same as that in 40 CFR §60.2(v).
7. "Principal Organic Hazardous Constituents (POHC's)" are the one or more organic constituents in a waste to be incinerated to which the Destruction and Removal Efficiency (DRE) standard in §264.343(a) applies. POHC's will be designated by the Regional Administrator:
 - (1) based on the results of the waste analysis performed under §264.341, and
 - (2) utilizing the criteria in §264.342(b) of this Section.
8. "Treatment" means any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize

such waste or so as to render such waste non-hazardous, safer for transport, amenable for recover, amenable for storage, or reduced in volume.

9. "Treatment facility" means a plan or part of a plant where treatment (as defined in RCRA) is conducted.
10. "Trial burn" means a temporary experimental burn of a hazardous waste in an incinerator permitted under §122.27(b) and for the purpose of evaluation of the capability of an incinerator of that design to achieve a specified performance (destruction and removal efficiency) and to establish the operating conditions (temperature, air flow, etc.) necessary to achieve that performance for purpose of the incinerator permit.

II. NEED TO REGULATE INCINERATION

A. Potential for Damage from Unregulated Incineration

The Agency encourages incineration in properly designed and operated facilities as a management technique which is preferable to land disposal of hazardous wastes. Incineration is capable of destroying most of the hazardous nature of organic wastes, while simultaneously reducing the volume of remaining wastes. Tests conducted by EPA and others demonstrate that incineration of a broad range of hazardous wastes can be conducted safely using existing technology if proper incinerator design and operating parameters are employed.⁽⁵⁾ (See discussion of DRE and in Part VI of this document.)

However, incineration of hazardous waste also poses a potential threat to human health if not properly conducted and controlled. This threat stems primarily from the potential emissions of hazardous substances into the air during incineration. This potential exists because the flow of air into the incinerator for combustion purposes can carry out with it part of the unburned waste fed into the incinerator. Unless captured in an emission control device, the waste will be discharged into the air. Similarly, if combustion is incomplete, hazardous combustion by-products, or recombining, may be formed in the combustion zone and subsequently emitted from the stack.

The potential for damage to human health and the environment from these emissions is related to several factors: the mass emission of hazardous substances from the stack, the dispersion of these emissions and extent of exposure of humans or other

organisms to them, and the health impacts of these substances due to exposure. Each of these factors is discussed below, beginning with the latter.

1. Health impacts

The range of potential emissions from incinerators is at least as large as and probably larger than the range of wastes, and includes thousands of different substances. The full extent to which these substances are hazardous to human health is not always known in most cases, but sufficient evidence exists to show that hundreds of the substances cause damage to human health. In the regulations promulgated on May 19, 1980 (45 FR at 33132). EPA included a list (Appendix VIII in Part 261) of over 400 substances known to be hazardous under certain circumstances.

Many of these substances are likely to be present in wastes which are incinerated. For example, sludges from oil and solvent recovery operations often contain heavy metals including lead, chromium, and cadmium (28). Improperly controlled incineration of these sludges could result in significant air emissions of these hazardous heavy metal constituents, or other toxic chemical compounds formed from them (1).

Similarly, improperly controlled incineration can allow quantities of cancer causing compounds to be released to the atmosphere. Included in Appendix VIII are approximately 150 suspected of being carcinogenic. These materials are constituents of many wastes; e.g., toxaphene used to control pests on ovestock; 1, 1, 1, - trichloroethylene, known to be in the heavy distillation waste bottoms from many chlorinated hydrocarbon

manufacturing plants; benzene, a widely used chemical found in wastes from painting and coating operations.

When these known carcinogens are incinerated, if combustion conditions are not properly maintained in the incinerator, quantities of these compounds will be emitted from the stack and may affect the health of those humans exposed to them.

Also, halogens and hydrogen halides (Cl_2 , HCl , etc.) are formed in combustion processes when halogenated organic compounds are burned. These compounds when released to the atmosphere adversely effect human health and the environment. Incinerators which are operated without adequate air pollution control equipment or with ineffieicnt devices can emit dangerous quantities of these halogens and their compounds.

2. Exposure

Hazardous waste is generated near population centers and incinerators are typically located near the point of generation. Hazardous waste incinerators are currently located near major population centers such as Philadelphia, Pa., Baton Rouge, La., Galveston, Tx. and many others. Depending on local terrain, meteorological factors, and population distribution, the number of persons exposed and the concentrations to which they are exposed can vary widely for any given emission level. Various air dispersion models have been developed to predict this exposure and those models have been used extensively in regulations promulgated under the Clean Air Act.

3. Hazardous Emissions

Finally, there is a potential that incineration will be

conducted improperly, yielding stack emissions of hazardous substances. In the past, hazardous wastes have been burned in open pits, in drums and in makeshift burners. (29) Burning often has taken place without emission controls and with combustion conditions inadequate to ensure proper destruction. Incomplete combustion can often result. This can occur because the waste is particularly difficult to destroy, because the incinerator is not properly designed to burn the waste in question, or because combustion conditions or emission controls are inadequate.

Appendix I illustrates the incinerability of the wastes listed as hazardous in Part 261 (45 FR 33119, May 19, 1980). The types of incinerator appropriate to these wastes are also indicated. The information in Appendix I is intended to be an indicator of the appropriateness of incineration for certain wastes. Actual conditions will vary for other wastes and from case to case depending on a variety of factors related to the waste and incineration system. However, this information lends support to the concern that burning of hazardous waste can be done improperly if wastes which are difficult to combust are burned, or if wastes are burned in improperly designed incinerators.

Even properly designed incinerators have limitations regarding the kinds and characteristics of the hazardous materials they can safely treat (see Appendix C). Significant amounts of water or other noncombustible components of the waste can affect incineration temperatures, appropriate feed rates, the amount of auxiliary fuel necessary, and the adequacy of control equipment.

Failure to respect these limitations increases the probability of environmental and human health damage from incinerator emissions and residues. Part VI of this document, discussing destruction and removal efficiency, further amplifies this point.

B. Incidents Involving Improper Incineration

Incineration of hazardous wastes has been less widely practiced than land disposal, and stack emissions and ambient air have seldom been monitored for many of the hazardous constituents present in hazardous wastes. Even so, several damage incidents and near incidents have come to the Agency's attention. A few, summarized below, serve to illustrate the potential problems associated with improper incineration:

1. In early 1974, following reports of air and ground water pollution caused by the incineration of hazardous wastes, the Air Compliance Division of the Connecticut Department of Environmental Protection closed two organic solvent recovery operations. One of the operations, in Southington, Connecticut, was contaminating the air with heavy metals from the incineration of solvent recovery sludges which contained lead and zinc. Additionally, the company's operations contaminated the soil and ground water in the area and the company's own well. Incineration ceased in early 1974. In Beacon Falls, Connecticut, a similar operation was closed for reasons of air pollution (30).
2. An incinerator in Grafton, Ohio, has been the target of numerous citizen complaints of unpleasant odors and air pollution. Odors, which normally signify organic emissions, are a common problem at incinerators due to the volatility of many of the wastes. Release of odoriferous materials usually occurs as a result of careless handling of the waste, fugitive emissions, or incomplete combustion. The area surrounding the facility is reported to have become contaminated with unburned Kepone on one occasion (31).
3. An on-site investigation by EPA officials at a closed hazardous waste facility in Seymour, Indiana, revealed that a makeshift incinerator had been used to destroy

hazardous wastes. The unit was little more than an open burning operation with an air blower to supply extra air (31).

4. An incinerator in Chicago, Illinois, was shut down in August 1976, after numerous violations of stack emission standards. The City of Chicago was able to close the facility down when three violations of air standards (particulates, opacity, and odors) occurred within a 180-day period. The facility has since reopened, after extensive modification of its air pollution control equipment. To date, the City has issued permits allowing only a limited number of wastes to be burned (32).
5. In April 1977, the State of New York shut down a liquid waste incinerator run by Pollution Abatement Services at Oswego, New York. The facility was a constant source of odor complaints from local residents. The State Division of Air Resources sampled the incinerator stack several times and found, in one case, a particulate level of 10 times the allowable limit. After the facility was closed the State of New York was left with a one-million gallon lagoon, four 50,000-gallon tanks and 8,500 drums of waste materials (32).

The above cases illustrate potential for emissions of substances which could cause damage.

C. Other Federal Regulations

The Agency has considered the extent to which existing Federal regulations address the potential problems associated with incineration of hazardous wastes, and the extent to which such regulations could provide inputs to further regulation, if needed, under RCRA.

1. Federal Regulation - Clean Air Act

The existing Federal Regulations most directly related to the issue of hazardous waste incineration are those promulgated under the Clean Air Act (CAA). As discussed in Part IV of this document, comments received on the proposed regulations suggested that incinerators should be regulated only under the

Clean Air Act.

Under the Clean Air Act, EPA has promulgated National Ambient Air Quality standards for ubiquitous pollutants such as sulfur dioxide, and for certain hazardous air pollutants such as lead. Emission standards called National Emission Standards for Hazardous Air Pollutants (NESHAPs), have been promulgated for certain hazardous pollutants from specific sources. However, these Clean Air Act Standards do not apply to hazardous waste incinerators in most instances. Finally, Standards of Performance for New Stationary Sources (NSPS) have been promulgated, but do not include hazardous waste incinerators.

None of these standards deal with the hundreds of toxic chemicals entitles which could be emitted as a result of improper incineration of the wide variety of chemical species that make up "hazardous wastes". While national standards under the Clean Air Act may be developed for some of these substances in the future, comprehensive national emissions standards would require many years of development at best, and as such, the CAA is not a practical option for control of hazardous waste incineration at this time.

Current Clean Air Act regulations and their relationship to hazardous waste incineration are summarized in general terms below:

National Ambient Air Quality Standards. The criteria pollutants identified in current CAA regulations include: sulfur dioxide, nitrogen dioxide, ozone, hydrocarbons, lead, and total suspended particulates. There are national ambient air

quality standards for each of these pollutants. Each State is required to have a State Implementation Plan (SIP) designed to achieve these standards within a specified time period.

To the extent that any of these pollutants are emitted by hazardous waste incinerators, they will come under State review as a part of the SIP. In developing the incinerator regulations under RCRA, the Agency considered the controls on criteria pollutants under the Clean Air Act.

National Emission Standards for Hazardous Air Pollutants.

To date, regulations under the CAA have addressed six hazardous air pollutants directly. These are mercury, lead, beryllium, vinyl chloride, asbestos, and benzene. These standards apply only to specific sources named in the regulations. Waste incinerators are identified as sources in only two of the standards. The beryllium standard is applicable to incinerators and the mercury standard is applicable only to incineration of waste water treatment sludge.

Standards of Performance for New Stationary Sources.

Regulations have been developed for certain stationary sources (currently about 28) with respect to certain pollutants. For example, standards for fossil fuel combustion sources place stack emission limits on particulates, SO_x and NO_x . Similarly, standards for sulfuric acid plants place emission limits on sulfuric acid mist.

Two types of incinerators are covered in these standards - municipal solid waste incinerators and sewage sludge incinerators. In both cases the standards include limits on particulates

only. Hazardous waste incinerators are not covered by these standards. The Agency has however proposed and has included in the final regulations for hazardous waste incineration, the same particulate emission standard applicable to municipal incinerators. (See discussion in Part VI of this document.)

Prevention of Significant Deterioration (PSD) and New Source Review. Procedures established under the CAA amendments of 1977 require that all new sources be subjected to a review process designed to prevent any further air quality degradation (by requiring offsets) in areas which are in non-attainment status for any of the criteria pollutants, and to ensure no significant deterioration in other areas. In carrying out this review, a state may be able to require application of best available control technology economically achievable (BATEA) for any emitted pollutant which is anywhere regulated under the Clean Air Act. This provides a potential vehicle for states to more broadly regulate emissions from new hazardous waste incinerators, but it applies only to new sources and its effectiveness in practice is not yet known.

2. Federal Regulations - Toxic Substances Control Act

The only federal regulations currently in effect which relate specifically to hazardous waste incineration are embodied in EPA's PCB disposal regulations.⁽³⁴⁾ These regulations require that certain PCB wastes be incinerated. Land disposal is not allowed for these materials. The regulation also includes destruction and combustion efficiency requirements; specifications for temperature, retention time, and excess air; require-

ments for inspecting (monitoring) operating conditions; and for automatic feed cutoff in the event of a malfunction. The PCB regulations also call for formal test burn procedures and for the use of scrubbers. The requirements parallel the proposed RCRA regulations to a considerable degree, and were helpful during development of the proposed regulations, primarily in suggesting alternative regulatory approaches and ensuring comprehensiveness of coverage. To ensure consistency in the regulation of all hazardous wastes, the Agency intends to integrate in the near future the regulation of PCB's under the Toxic Substances Control Act with the regulation of all hazardous wastes under RCRA.

D. State Regulation of Incinerators

Some states have found it necessary to control hazardous waste incineration. The work done by these states in developing their regulations and their experience in implementation were reviewed by the Agency during development of these final regulations.

In the absence of regulations specifically addressing emissions from incinerators burning hazardous waste, some states have restricted the operations of hazardous waste incinerators by the authority of a general protection or "nuisance" rule. The following general nuisance rule of the Wisconsin Department of Natural Resources is typical:

NR 154. Control of Hazardous Pollutants. General Limitations

No person shall cause, suffer, allow, or permit emissions into the ambient air of hazardous substances in such quantity, concentration, or duration as to be injurious to human health, plant,

or animal life unless the purpose of that emission is for the control of plant or animal life. Hazardous substances include, but are not limited to, the following materials, their mixtures, or compounds: asbestos, beryllium, cadmium, chlorine, fluorine, lead, mercury, pesticides, or radioactive material (35).

While this type of rule provides no specific regulatory guidelines, the general authority of similar statutes has been used to impose a variety of emission restrictions on a case-by-case basis in some states.

Several states have recognized the importance of developing more complete regulations for hazardous waste incineration and are actively pursuing development of additional regulations.

However, in general the current regulation of hazardous waste incineration by states does not provide the kind of comprehensive regulation necessary to protect human health and the environment that RCRA requires.

III. SUMMARY OF THE PROPOSED REGULATIONS

Given the Congressional mandate to protect human health and the environment and the need for regulation of incineration to accomplish that objective as described in Part II, the Agency proposed regulations for incineration of hazardous wastes on December 18, 1978 (43 FR at 59008). These regulations were proposed under 250.45-1 as standards applicable to the permitting of hazardous waste incinerators. No interim status standards were proposed for incineration. The proposed regulations contained the provisions summarized below:

Trial burns

Trial burns were required for each hazardous waste which was significantly different from wastes burned previously under equivalent conditions. The trial burns were to include:

- Analysis of wastes for halogens and principal hazardous components
- Analysis of ash residues and scrubber effluent for principal hazardous components
- Analysis of the exhaust gas for principal hazardous components, hydrogen halides, CO, CO₂, O₂, and particulates
- Identification of sources of fugitive emissions and their control
- Measurement of combustion temperature and residence time
- Computation of combustion efficiency and destruction efficiency

- Computation of scrubber efficiency in removing halogens.

Monitoring

Monitoring of the following parameters were required in both the trial burn and each operational burn:

- Combustion temperature on a continuous basis
- CO and O₂ in the exhaust gas on a continuous basis
- Rate of hazardous waste, fuel, and excess air fed to the combustion system at intervals not exceeding 15 minutes.

Combustion Criteria

- The incinerator was required to operate at greater than 1000° C combustion temperature, greater than 2 seconds retention time, and greater than 2 percent excess oxygen for all hazardous wastes except halogenated aromatic hydrocarbons.
- For halogenated aromatic hydrocarbons the incinerator had to operate at greater than 1200° C combustion temperature, greater than 2 seconds retention time, and greater than 3 percent excess oxygen.
- The incinerator had to operate at a combustion efficiency (CE) of at least 99.9 percent defined as follows:

$$CE = \left(\frac{C_{CO_2}}{C_{CO_2} + C_{CO}} \right) \times 100$$

where C_{CO₂} and C_{CO} are concentrations measured in the exhaust gas

- The incinerator had to have a device to automatically cut off feed to the incinerator when significant changes occurred in combustion temperature, excess air, or scrubber water pressure.

- The incinerator had to achieve a destruction efficiency (DE) of 99.99 percent as defined by the following equation:

$$DE = \left(\frac{W_{in} - W_{out}}{W_{in}} \right) \times 100$$

Where: W_{in} = mass feed rate of principal toxic components of waste going into the incinerator

W_{out} = mass emissions rate of principal toxic components in waste in the incinerator combustion zone

- Incinerators burning waste containing more than 0.5 percent halogens had to be equipped with emission control equipment capable of removing 99 percent of the halogens from the exhaust gases.
- The incinerator had to meet a particulate emission standard of 270 milligrams per dry standard cubic meter at zero excess air (0.08 grains per dry standard cubic foot at 12 percent CO_2).
- The incinerator had to be designed and operated to control fugitive emissions of unburned hazardous waste and combustion products.

IV. Interim Status Standards

A. Introduction

This section discusses the interim status standards promulgated on May 19, 1980 and the modifications to those standards which are now being made as a result of comments received and need to make the interim status and general standards consistent.

Paragraphs B and C discuss the interim status standards as promulgated on May 19, 1980. These standards were promulgated on an interim final basis and thus were subject to comment. Paragraph C discusses the comments received and the subsequent changes which are now made. Included in paragraph C are the modifications which the Agency is making to the ISS to make them consistent with the general standards now being promulgated. Paragraph D contains the final language of the interim status standards.

B. Basis for the Interim Status Standards (ISS)

1. Interim Status Standards (ISS)

As summarized in Part III of this document, the Agency proposed a full set of standards for incineration on December 18, 1978 in response to the Congressional mandate in Subtitle C of RCRA. The proposed regulations included general standards used in issuing permits but no interim status standards. Interim Status Standards (ISS) are applicable during the period of time between submittal of an application for a permit and the granting of a permit.

The Agency subsequently determined that it is important to bring some additional control over incineration and other thermal treatment by promulgating additional interim status standards. Such standards for incinerators were promulgated 45 FR 33250, May 19, 1980. This section of this document discusses those regulations which are to be in effect during the interim status period. General regulations for incineration, those which apply to permitting, are discussed in Parts V and VI.

The interim status standards have been organized to bring together all of the regulations from the December 18, 1978 proposal that will most directly affect hazardous waste incineration facilities during the period between the time they apply for a permit under the General Standards and the time the Agency completes action on that application. Thus, the inspection and the waste analysis requirements specific to incinerators, which were separately listed in the 1978 proposal, have now been listed in the ISS for incinerators.

One requirement, not included in the December 18, 1978 proposal, has been included in the interim status regulations. This is a requirement that waste be burned only at proper operating temperatures. This requirement is consistent with the ISS criteria, and was brought to the Agency's attention by a commenter

asking for an operational variance during start-up periods. This commenter made the Agency aware of a serious potential for environmental hazards. Thus, the requirement of pre-heating to proper operating conditions before burning hazardous wastes was added to the interim status standards.

A commenter suggested that the proposed standards for trial burns and operational emissions monitoring be made applicable during the ISS period. Since such an application does not meet the ISS criteria (outlined below), the Agency has not done this.

2. Criteria for ISS

In general, the Agency used the following criteria to indicate which regulations should be adopted during the ISS: (1) could reasonably be implemented by the regulated community within the six-month period between promulgation and the effective date of the ISS regulations on November 19, 1980; (2) does not require large capital expense for items which require approval and, thus, might be altered as part of the permitting process; and (3) can be implemented directly by the regulated community with the need for minimal consultation with, or interpretation by, the Agency. The rationale for these decision criteria is discussed in the preamble to the Part 264 and 265 regulations promulgated on May 19, 1980 and in the Background Document entitled "General Issues Concerning Interim

Status Standards." It should be understood, however, that the Agency used the criteria only as guidance in deciding which standards to require during interim status. They are not hard-and-fast rules.

For incineration facilities, the proposed technical performance and design requirements do not meet the decision criteria and, thus, cannot readily be implemented during interim status. The time required for conducting trial burns and upgrading most existing facilities could be considerable, and the designs will require Agency approval during the permitting process. The Agency has, however, developed threshold standards for incineration which can be implemented during the interim status period. These have been designed primarily to improve operating procedures, i.e., to eliminate the careless and sloppy practices which have resulted in serious problems in the past. They do meet the criteria for ISS.

Specifically, requirement §265.343, that the incinerator be brought to its steady state operating condition before hazardous wastes are introduced meets the criteria because: (1) it requires no EPA approval or interpretation, (2) any capital expenditures necessary to install auxiliary fuel capability are not likely to be a topic of disagreement during permitting activities, and (3) it can be implemented with little lead time needed to obtain and install equipment.

The requirement of §265.345, that off-site hazardous wastes be analyzed before the owner or operator treats them, meets the criteria because: (1) it can be implemented with no EPA involvement, since the sampling and analytical procedures are largely left to the owner or operator; (2) it can commence as soon as any necessary testing equipment is delivered; and (3) it requires only limited expense for the purpose of procuring testing equipment (often already available).

The requirement of §265.347 for instrument monitoring and inspection of control equipment and emissions meets the criteria because: (1) it can be begun by incinerator operators immediately, (2) it requires no interpretation by the Agency, and (3) it requires no capital expenditures, since only existing, in-place equipment and instruments must be inspected.

Finally, the requirement §265.351, that hazardous waste and hazardous residues (including sludges, ash, etc.) be removed from the incinerator at closure will be incorporated as part of the closure plan required by Subpart G (Closure and Post Closure) to be prepared during interim status. This will be subject to Agency review and approval before it is implemented. Implementation of these requirements will not be necessary until closure which may be years in the future but they may require significant capital expenditures. These rules are being promulgated despite the interim

status criteria because of the importance the Agency places on proper closure. For further discussion of the closure requirements during interim status see the background document entitled "Closure and Post-Closure Care."

C. Interim Status Standards Promulgated on May 19, 1980, Including Response to Comments on December 18, 1978 Proposal and Rationale for Interim Final ISS.

Many of the comments received went to technical points or issues that are resolved in the General Status (Phase II) Regulations. These are discussed in section VI. Other comments raised issues relevant to any RCRA regulation of hazardous waste incineration. These are discussed immediately below. Finally, comments specifically relevant to the Interim Status Standards are discussed after the general issues raised.

General Issues

1. Summary of Comments

- a. Incineration should be regulated only in three ways: emissions should be controlled by the Clean Air Act, effluents by the NPDES system, and land disposal by Subtitle D of RCRA. Legislative history does not indicate that Section 3004 "disposal" was intended to include incineration.
- b. Design and operation regulations are a mistake. The owner or operator should be allowed to determine how to operate the process so as to meet performance standards.

2. Analysis of and Response to General Issue Comments

- a. Hazardous Waste Incineration Falls Within the RCRA Statute

The commenters' discussion of whether hazardous waste incineration falls within the Section 1004(3) definition of "disposal" is irrelevant. The Agency is regulating incineration as "treatment" of hazardous wastes.

Section 1004(34) defines treatment:

The term "treatment," when used in connection with hazardous waste, means any method, technique, or process, including neutralization, designed to change the biological character or composition of any hazardous waste so as to neutralize waste and render it non-hazardous, safe for transport, amenable for recovery, amenable for storage, or reduced in volume. Such term includes any activity or processing designed to change the physical form or chemical composition of hazardous waste so as to render it non-hazardous.

As a process designed to render hazardous waste non-hazardous and reduced in volume, incineration falls squarely within this definition. The Agency's statutory mandate to regulate such treatment processes is thus found in Section 3004, which requires that the Administrator promulgate standards for the treatment of hazardous wastes. This mandate also serves the objectives of the statute, defined by Congress in Section 1003(4) as, among other things, "regulating the treatment. . . of hazardous wastes which have adverse effects on health and the environment." In addition, incineration of hazardous

wastes was discussed extensively in EPA's 1974 Report to Congress: Disposal of Hazardous Wastes, a document that strongly influenced Congressional development of RCRA. The Administrator's authority in this matter is made even more clear later in Section 3004, which says that standards set by the Agency "shall include, but need not be limited to, requirements respecting--

- (3) treatment. . . of all such wastes. . . pursuant to such operating methods, techniques, and practices as may be satisfactory to the Administrator."

Some commenters suggested that the proposed regulations should be replaced by, or were in conflict with, the Clean Air Act. Congress, in Section 1006(b), required the Administrator to integrate RCRA with the Clean Air Act, but "only to the extent that it can be done in a manner consistent with the goals and policies expressed in this Act. . ." It is significant that Congress, in Section 1006(a), omitted the Clean Air Act from a list of statutes that were specified as unaffected by RCRA's provisions. As a result, the Administrator has substantial discretion to determine the interplay between RCRA and the Clean Air Act, so as to best effect the purposes of both statutes. Since incinera-

tion of hazardous waste poses dangers that are not adequately addressed in regulations promulgated under the Clean Air Act, it is appropriate to regulate such facilities under RCRA. Also, incinerator sites will be receiving manifested hazardous wastes, temporarily storing hazardous wastes, and (usually) generating hazardous wastes in their ash and scrubber effluents. Thus, some regulation under RCRA is essential in any case.

The Clean Air Act, as discussed above in Part II, controls air contaminant emissions largely on a pollutant-by-pollutant basis, or on a pollutant-facility basis. Its regulations include area-wide standards for relatively ubiquitous pollutants such as sulfur dioxide and lead, and for certain hazardous air pollutants, such as beryllium and vinyl chloride (examples are: particulates from steam fired power plants, and vinyl chloride emissions from vinyl chloride production plants).

The toxic pollutants which potentially could be emitted from incineration of hazardous wastes number at least in the hundreds. RCRA has authority to control emissions through performance standards and through operating and design standards. These standards can be more effectively applied

to control the entire mix of pollutants treated in each facility, than by attempting to develop a national emission standard under the Clean Air Act for each possible emission. Thus, the Agency has decided to regulate hazardous waste incinerators and other thermal treatment devices directly under RCRA. Further discussion of the sufficiency of Clean Air Act regulations is contained in Part II of this document.

Effluent discharges to surface waters, however, will require NPDES permits. These RCRA regulations do not cover surface water discharges. Finally, removal of ash or other residues generated by an incinerator to landfills or other sites will have to comply with RCRA hazardous waste regulations for generators if the waste is hazardous. The RCRA/NPDES interface is clarified in the Federal Register, November 17, 1980, 40 CFR, Parts 122, 260, 264, 265 and 266.

There are no provisions of regulations issued by the Agency under the Clean Air Act or the Clean Water Act which are incompatible with these RCRA requirements. It should be noted that the interim status standards do not apply to the incineration of PCB-containing wastes. These are regulated under 40 CFR 761.40. At a later time, the Agency intends to integrate the PCB requirements

with these RCRA requirements, as discussed in Part II of this document.

b. Performance Standards are the Best Approach

Commenters felt that design and operating standards are undesirable because they limit needed flexibility on the part of the owner or operator. They suggested that the owner or operator should be allowed to determine how to operate so as to meet performance standards.

The Agency believes that performance standards are desirable and, in fact, the destruction and combustion efficiency requirements and the halogen removal requirements which were proposed were types of operational performance standards. The use of performance standards tends to encourage innovative technologies and provides maximum cost-effectiveness and flexibility to the owner and operator. Specific design requirements, on the other hand, may freeze technology. The Agency does not agree, however, that RCRA regulations should depend solely and totally on performance standards.

There are a number of "good management practices," which are currently routinely practiced by the reputable and knowledgeable incinerator operators, which the Agency believes should be practiced by everyone, regardless of the waste and

incinerator types employed. Some of these "good management practices" have been included in these interim status regulations. These operating requirements are based on the belief that it is better to prevent injury to human health through careful management than to take after-the-fact enforcement measures when poor management has led to an inevitable breach of a performance standard. The issue of performance vs. operating standards is discussed further in Parts V and VI of this document.

Allowance of Variances During Startup Periods

1. Synopsis of the Proposed Regulations

The proposed regulations (Section 250.45-1(d)) required that incinerators operate at 1000°C with at least a two-second residence time and at least two percent excess air (except for halogenated aromatics which required 1200°C for two seconds and at least three percent excess air) whenever burning hazardous wastes. Similarly, a 99.9 percent combustion efficiency and 99.99 percent destruction efficiency were required whenever burning hazardous wastes. These standards are not requirements for the interim status period.

2. Summary of Comments

- a. Define a one-hour start-up period after wastes are introduced before destruction efficiency and combustion efficiency requirements are applied.

- b. Allowance should be made for excursions and operational variations during startups and shutdowns.

3. Analysis of and Response to Comments and Rationale for the Interim Final Regulation

The Agency cannot agree with the request for a variance during startup and shutdown times. Such an allowance would open the door to the possibility of an incinerator being allowed to discharge significant quantities of hazardous wastes albeit over a short time interval.

Test burns and industry literature indicate that it is good management practice, and entirely feasible, to use auxiliary fuel to bring the incinerator up to steady-state operating conditions before burning hazardous wastes. When preheating to standard conditions is coupled with careful control, dangerous temperature and residence time deviations can be eliminated when waste feed commences.(1,5).

While there may be a small increase in operating costs caused by increased reliance on auxiliary fuels, that cost will be outweighed by the human health benefits of proper incineration. Such a regulation, as a side benefit, will prevent unscrupulous owners and operators from gaining an economic advantage over reputable facilities.

The Agency agrees that combustion condition variations, with attendant deviations in destruction

efficiencies and increased emissions, are most likely to occur during startup periods. If the practice suggested by these comments becomes widespread, significant health and environmental damages are likely to result. Therefore, it is reasonable and necessary to require owners and operators of existing facilities to achieve steady-state operating conditions within the incinerators using auxiliary fuel before introducing any hazardous waste. Reputable firms currently practice this safeguard, regardless of the design capability of their incinerator.(36)

4. Summary of the Interim Final Regulations

As a result of comments received related to combustion efficiency deviations during startup periods, the Agency is requiring (Section 265.343) all incinerators during the interim status period to achieve steady state temperature and air flow conditions using auxiliary fuel before adding any hazardous waste.

Analysis of Wastes

1. Synopsis of the Proposed Regulation

In Section 250.43(g) of the proposed General Facility Standards, the owner or operator of any facility, including an incinerator, was required to obtain a detailed analysis of each hazardous waste stream at least annually. Also, owners and operators were required (Section 250.43(h)) to sample each

truckload of hazardous waste received and analyze it for appearances, specific gravity, pH, and vapor pressure.

In the incineration section (Section 250.45-1(b)(1) (i), (ii), and (iii)), these requirements were proposed to be extended to trial burns by requiring analysis of: (1) the waste for halogens and principal organic hazardous components, (2) ash and scrubber wastes for principal hazardous components, and (3) exhaust gas for halides, CO, CO₂, O₂, and particulates.

2. Comments Received

Most of the general comments received on these requirements are addressed in the Background Document entitled "Waste Analysis." The few comments relating specifically to incinerators can be summarized as follows:

- a. Required testing and analysis are unnecessary for certain wastes, or are too expensive.
- b. It is not clear what is to be tested and what owners and operators are to do with the information thus gathered.
- c. Testing should not be required except to:
(a) identify waste as hazardous and (b) provide necessary information to the owner or operator to allow him to make decisions concerning safe management.

3. Analysis and Response to the Comments and Rationale for the Interim Final Regulation

The Agency based the proposed general requirements for making a detailed chemical and physical analysis of the wastes on the belief that, to properly determine

the adequacy of a facility (incinerator, in this case) to manage a given waste, the operator must know something about the waste (compatibility, heating value, primary pollutants, etc.). However, since the necessary properties varied by facility type (i.e., tanks, incinerators, or landfills), the Agency did not specify exactly what should be tested for, except in the case of incineration where analysis of halogens and hazardous components was mandated for trial burns in order to determine the efficiency of the incinerator for removing the halogen and destroying the principle hazardous components. A number of commenters on other sections agreed with the second commenter, i.e., that the standard did not adequately spell out what is to be tested and what is to be done with the information obtained. The Agency agrees and has decided to require all facility owners and operators to develop a waste analysis plan which will detail the characteristics of a waste which he must know in order to adequately manage the waste. This plan is discussed in detail in the background document entitled "Waste Analysis." However, since all owners and operators are not equally knowledgeable, the Agency has decided to place minimum and more specific analytical requirements within the facility regulation sections. This will guarantee that, as a minimum, owners and operators will obtain at least rudimentary information on a new hazardous waste which will enable

them to evaluate the capability of their equipment and techniques to manage it.

The Agency will not require trial burns for wastes to be incinerated under ISS. Trial burns are fully useful only in conjunction with the permitting process. Nevertheless, reputable incinerator operators have found it necessary to know certain waste characteristics prior to burning wastes which they have not previously burned (58, 59). Based on such industry experience, the Agency will require incinerator operators to include the following information on new wastes in their waste analysis plan during interim status: heating value, halogens, sulfur, lead, and mercury.

Heating value analysis is necessary to determine adequate operating parameters, such as rate of auxiliary fuel feed. Hydrogen chloride and sulfur dioxide are commonly recognized air pollutants which result from combustion of wastes containing chlorinated organic compounds and sulfur compounds. In addition to their effects on human health, sulfur dioxide emissions are causative agents for an increasingly worrisome problem - acid rain. Also, hydrogen halides, particularly HCL and HF, can cause serious corrosion problems in a thermal treatment system. This can lead to rapid deterioration of the structural and operating integrity of the thermal treatment system.

Lead is oxidized during combustion and is emitted from uncontrolled incinerators as a particulate (37). Lead has been found to produce an adverse effect on public health. The Criteria Document for lead which served as a basis upon which the Administrator on October 5, 1978 published a National Ambient Air Quality Standard for lead summarizes the relationships between airborne lead and its effects on man (38). Lead enters the body principally through ingestion and inhalation with consequent absorption into the blood stream and distribution to all body tissues. Uncontrolled incineration of waste containing lead can be a significant lead emission source. EPA set ambient air quality standards for lead in 43 FR 46246. They were affirmed by the Court of Appeals for the D.C. Circuit. Lead Industries vs EPA, ____ F.2d. ____, (June 27, 1980).

Mercury compounds vaporize readily when heated and, during combustion, may be emitted to the atmosphere. Mercury has been found to cause or contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness. On March 31, 1971, the Administrator listed mercury as one of three hazardous air pollutants for which he intended to establish emission standards (39). The publication entitled "Background Information on Development of National Emission Standards for Hazardous Air Pollutants; Asbestos, Beryllium and Mercury" describes

the health criteria for these EPA standards for mercury (40). Methyl mercury is considered to be the most hazardous of mercury compounds. The National Emission Standard for Mercury published under the authority of Section 112 of the Clean Air Act on October 14, 1975 is applicable to stationary sources that incinerate wastewater treatment sludge (40).

As more information is received, the Agency may add to or modify minimum analysis requirements. Also, the general regulations discussed in Parts V and VI contain additional waste analysis provisions. During interim status, (and permanent status) facilities must, of course, comply with relevant Clean Air Act limitations. For example, 40 CFR 61.52 prescribes emission limits for mercury from incinerators of wastewater treatment sludges. Also, 43 FR, 46246-46277 sets ambient air standards for lead which should not be exceeded as a result of emissions from any stationary source. Most incinerator operators find it useful to obtain additional information such as viscosity and solids content, but the Agency believes that certain types of facilities would not need this information to operate safely. Therefore, viscosity and solids content analyses are not required for all incinerators. Where they are relevant (e.g., liquid injection), they must be included in the waste analysis plan.

ISS criteria will be in effect throughout the interim status period. The Agency has decided that the additional cost of these analyses will be warranted. The dangers of not properly analyzing wastes prior to incineration are too high to be tolerated throughout the potentially lengthy ISS period prior to the issuance of a permit.

Thus, the Agency disagrees with the first comment that basic information which will allow an evaluation of combustibility and pollutant potential can be "too expensive" or unnecessary. The Agency has dropped the requirement for annual reanalysis to reduce expense for possibly unnecessary analytical work. Since the requirement is for a one time analysis, the cost, using standard laboratory analytical procedures, would usually be less than \$500 (41,42). Incinerator operators can ask the generators to provide this information or else analyze the waste themselves and include the cost in their charges to the generator (43,44).

4. Summary of the Interim Final Regulation (§265.345)

§265.341 Waste analysis

In addition to the waste analyses required by §265.13, the owner or operator must sufficiently analyze any waste which he has not previously burned in his incinerator to enable him to establish steady state (normal) operating conditions (including waste and auxiliary fuel feed and air flow) and to determine the

type of pollutants which might be emitted. At a minimum, the analysis must determine:

- (a) Heating value of the waste;
- (b) Halogen content and sulfur content in the waste; and
- (c) Concentrations in the waste of lead and mercury, unless the owner or operator has written, documented data that show that the element is not present.

[Comment: As required by §265.73, the owner or operator must place the results from each waste analysis, or the documented information, in the operating record of the facility.]

Instrument Monitoring and Facility Inspection

1. Synopsis of the Proposed Regulation

During both trial and operating burns, the following parameters (§250.45-1(c)) were to be monitored and recorded:

- a. combustion temperature
- b. exhaust gas CO and O₂ concentrations continuously, and
- c. waste, fuel, and excess air feed at least every 15 minutes.

These requirements were not proposed for the interim status period.

2. Summary of Comments

- a. New equipment to monitor gas emissions (particularly CO) would be expensive.

- b. 15-minute inspection of waste flows is unnecessarily rigorous.
- c. Points of measurement are unclear.
- d. NO_x, SO_x, and CO₂ should be added to the list of monitored effluents. One commenter suggested they be included during interim status.

3. Analysis of and Response to Comments and Rationale
for the Interim Final Regulation

The Agency believes it unwise to require specific monitoring equipment, such as the proposed continuous oxygen and carbon monoxide instrumentation, during the interim status period. The first commenter is correct: this equipment is expensive and complex (45). The design of these systems and sampling requirements will be the subject of Agency review during the permit process and, thus, it is unwise to require installation before that analysis can take place. Also, lead time on purchases of instrumentation of this type can be lengthy. Elapsed time for design and installation would probably have exceeded the available six months. For similar reasons, the Agency does not believe that NO_x, SO_x, and CO₂ measurements should be required during interim status, as was suggested by one commenter.

At this time, however, it appears that at least some of the benefits of monitoring and inspecting can be realized simply by requiring that combustion and emission control monitoring equipment already in place be monitored on a regular basis. Also appropriate corrections should be made, if this will ensure that (within the design limitations of the existing equipment) the combustion and emission control conditions will

not be allowed to wander unmonitored and uncontrolled. It also seems reasonable and prudent to set up routine inspection schedules to observe visible emissions from the stack, as well as leaks, spills, and inoperative alarm and control systems. As discussed in the Background Document for Inspections, routine inspections can often detect a malfunction or operator error in advance of a possible human health or environmental incident.

EPA disagrees with the commenter who stated that a 15-minute inspection frequency for waste flow is unnecessarily rigorous. The instruments (or other devices) which measure the combustion conditions (temperature, retention time, excess air, and turbulence) should be monitored and corrections made as often as possible, continuously and automatically where possible. The relevant control points on which the combustion conditions depend in most incinerators include waste feed rate, auxiliary fuel feed, and air flow. Variations in any of these, or in the heating value of either the waste or the auxiliary fuel, can lead within minutes to poor combustion conditions and to emission of incompletely burned wastes. Some facilities already have some of these control loops (temperature via auxiliary fuel flow, for example) operating on a continuous basis (36). The Agency encourages such continuous control, but will insist that any such controls and, even more importantly, any manual control loops (where the operator makes the correction) be monitored or inspected at least every 15 minutes.

No specific data base could ever demonstrate the wisdom of the precise 15-minute frequency. It is based on the Agency's

generalized engineering expertise and the specific knowledge of incinerator operations gained in the 1975 and 1976 test burns. In some cases, where combustion conditions are subject to rapid variations arguments can be made that more frequent monitoring and control is needed. This is, however, a facility-specific situation and depends on design parameters, such as the effectiveness of the instrumentation and the response period once control changes are made. Also, the consequences of incomplete combustion could be severe depending on the type of hazardous waste being burned. Thus, monitoring frequency is more appropriately treated during the permitting process. In developing the inspection schedule required in §265.15, more frequent monitoring and control activities should be conducted where appropriate (see the Inspection Background Document for discussion of Inspection Schedule development).

The 15-minute schedule is a minimum. The Agency does not believe that control loops which affect combustion conditions and, thus, combustion efficiency should ever be allowed to wander out of control for longer than that period of time. Even where automatic control is installed, it is necessary to check the instrumentation to ensure that it is functioning. The 15-minute minimum ensures that improper conditions do not persist for longer than that period. Because of the short time interval between a malfunction and possible emission of hazardous materials, no incinerator of hazardous wastes should operate unattended.

The Agency feels similarly about existing control loops which might result in emissions or which could result in spills. These could vary, depending on the design of the equipment, but often include scrubber water flows, scrubber water pH and, perhaps, level controls on tanks. They must similarly be inspected on a 15-minute basis. All of these inspections are to be part of the Inspection Schedule called for in Section 265.15, and significant results are to be recorded in accordance with the provisions of that section.

In addition, stack emissions should be monitored hourly and the entire facility inspected at least daily for leaks, spills, fugitive emissions, odors, and smoke. All of these can result in human health or environmental impacts if not detected early. Control system alarms must also be inspected daily to be sure they are functioning. Again, no body of information can specifically support any given frequency. Based on its own experience, however, with incinerator test burns, the Agency believes that inspections at these frequencies will uncover problems in time to prevent serious incidents. Further, the cost impact of conducting these inspections is expected to be small, given the fact that an operator must be on duty to run an incinerator anyway. For further discussion of the rationale for routine inspections, the reader is referred to the background document on inspections.

4. Summary of the Interim Final Regulations (§265.347)
§265.347 Monitoring and inspections

The owner or operator must conduct, as a minimum, the

following monitoring and inspections when incinerating hazardous waste:

(a) Existing instruments which relate to combustion and emission control must be monitored at least every 15 minutes. Appropriate corrections to maintain steady state combustion conditions must be made immediately either automatically or by the operator. Instruments which relate to combustion and emission control would normally include those measuring waste feed, auxiliary fuel feed, air flow, incinerator temperature, scrubber flow, scrubber pH, and relevant level controls.

(b) The stack plume (emissions) must be observed visually at least hourly for normal appearance (color and opacity). The operator must immediately make any indicated corrections necessary to return visible emissions to their normal appearance.

(c) The complete incinerator and associated equipment (pumps, valves, conveyors, pipes, etc.) must be inspected at least daily for leaks, spills, and fugitive emissions, and all emergency shutdown controls and system alarms must be checked to assure proper operation.

Residue Management and Closure Requirements

1. Synopsis of the Proposed Regulation

In the proposed General Facility Standards (§250.43(e)) regulations, the owner or operator of any facility (including an incinerator) was required to consider any residue generated by the treatment (or storage) of a hazardous waste as a hazardous waste.

2. Summary of Comments

1. Regulations must specifically address the disposition of incinerator ash.
2. Regulations must protect human health and the environment from the leachate of hazardous waste ash which is temporarily stored.
3. The California State leaching test should be used to determine the leaching potential of ash from incineration of hazardous wastes.

3. Analysis and Response to Comments and Rationale for the Interim Final Regulation

The Agency agrees with the first comment and in a comment in the interim final regulations, has clarified the requirement that waste from incineration of a hazardous wastes is also hazardous. Section 261.3(c) should also address the concerns of the second commenter since leachate discharged from the stored ash resulting from incineration of a hazardous waste would also be a hazardous waste unless either the leachate or the ash had been tested and found not to be hazardous in accordance with §260.22. The Agency responded to these comments in this way because of the difficulties in designating toxic wastes. These problems are outlined below. For a fuller discussion, see the background document entitled "Criteria for Listing/Delisting."

The Agency has determined that test procedures for identifying if a waste is toxic by virtue of its being carcinogenic, mutagenic, teratogenic, or bioaccumulative have not been sufficiently developed for routine use by waste generators in determining if their waste is subject to regulation. Part 261 now is limited to test procedures that focus on the concentration

in the waste of those metals and pesticides for which there are National Primary Drinking Water Standards. These procedures have been sufficiently developed and will be used by waste generators to determine if their waste is a toxic waste and thus subject to regulation. Despite the current lack of sufficiently developed test procedures the Agency has retained comprehensive criteria for listing other toxic wastes including those which are carcinogenic, mutagenic, teratogenic, and bioaccumulative. Thus, many wastes are listed as hazardous because data has shown that they are carcinogenic or otherwise toxic even though they do not meet the characteristics in Part 261.

This anomaly (a waste listed as hazardous for reasons other than its meeting one of the characteristic tests in Part 261) leads to some potentially troublesome loopholes. For example, an owner or operator could superficially "treat" a waste which is listed because it is carcinogenic and claim that the "treatment" has produced a new waste. And since the new waste (residue from the "treatment") is not listed and does not contain the heavy metals or pesticides which would cause it to fail the characteristic for toxicity in Part 261, it would not be considered hazardous and would be unregulated. It might, however, be just as carcinogenic as the original waste.

To close this loophole, the Agency has added a requirement (§261.3(c)) that "any solid waste that is discharged, spilled, or otherwise removed from a treatment, storage, or disposal

facility that contains any hazardous waste will continue to be considered a hazardous waste..." unless it can be shown to be nonhazardous in accordance with the delisting procedures in §260.22. Thus, any residue (ash, scrubber water, scrubber sludge, precipitator dust, etc.) deriving from incineration of any hazardous waste, is a hazardous waste itself, unless it has been delisted. For a more complete analysis of these requirements, the reader is referred to the background document dealing with the definition of hazardous waste.

The third comment suggested reliance on the 30-day California leaching test. This test would be more severe than EPA's Extraction Procedure promulgated under Part 261. The Agency's rationale for rejection of the California test is explained in the background document entitled "Toxicity Characteristic." The Agency is unable to require that incinerator ash residue from hazardous waste burns should be subject to a more severe test of hazard potential (the California test) than other potentially hazardous wastes which will be evaluated using EPA's Extraction Procedure.

To be consistent with the format and requirements of the other facility specific requirements (landfills, surface impoundments, etc.) and the closure and post-closure requirements (Subpart G), Section 265.351 has been reoriented to specify what must be done with residues at closure. Section 265.114 of the general closure and post-closure requirements specifies that equipment must be decontaminated and Section 265.113(a) requires that remaining hazardous wastes must be removed.

For incinerators, Section 265.351 amplifies and further defines these requirements specifying that remaining hazardous residues, including ash, scrubber waters, and scrubber sludges, must be removed at closure.

4. Summary of the Interim Final Regulation (§265.351)

§265.351 Closure

At closure, the owner or operator must remove all hazardous waste and hazardous waste residues (including but not limited to ash, scrubber waters, and scrubber sludges) from the incinerator.

[Comment: At closure, as throughout the operating period, unless the owner or operator can demonstrate, in accordance with §261.3(d) of this Chapter, that the residue removed from his incinerator is not a hazardous waste, the owner or operator becomes a generator of hazardous waste and must manage it in accordance with all applicable requirements of Parts 262 - 266 of this Chapter.]

D. Comments and Response to Comments on the Interim Final ISS

1. Operating Requirements

a. Summary of the Interim Final Regulation

§265.343 - General Operating Requirements requires that hazardous waste incinerators must be at steady state operating conditions before feeding hazardous wastes.

b. Comment on the Interim Final Regulation

1. Banning the use of high BTU hazardous waste to start-up incinerators is contrary to sound practice. Wastes which contain only carbon,

hydrogen and oxygen should be allowed as start-up fuel. EPA has failed to recognize degree of hazard.

c. Response to Comments on the Interim Final §265.343 and §265.340

The Agency believes that use of clean auxiliary fuel such as fuel oil or natural gas to start-up incinerators is a prudent and conservative requirement. The Agency realizes that there may be some wastes which are hazardous due only to their flammability and might well be suitable for start-up.

Thus, the Agency has decided to add an exemption to §265.340 of the interim status standards to exclude wastes which are hazardous due only to their ignitability from the preheating requirement in §265.343 (See Section VI of this document for a complete discussion of this exemption).

However, the Agency disagrees with the comment that wastes which have only hydrogen, oxygen, and carbon in their structure should be exempted from the preheating requirement. An example of such a waste material is benzene which contains only hydrogen and carbon but which is hazardous due to its carcinogenic properties. Thus, a waste containing benzene would be a threat to human health and the environment if it were not completely combusted in an incinerator.

The Agency has modified the requirement for start-up so that it also includes shut-down. The same health concerns apply in either case.

d. Final Interim Status Standard

§265.340 Applicability

- (a) The regulations in this Subpart apply to owners or

operators of facilities that treat hazardous waste in incinerators except as §265.1 and paragraph (b) of this Section provide otherwise.

(b) Incineration of wastes which:

- (1) Meet only the ignitability characteristic under Part 261, Subpart C, of this Chapter, or
- (ii) Are listed in Part 261, Subpart D of this Chapter for ignitability only (Hazard Code I)),

may be exempted from the requirements of this Subpart, except §265.351, if the owner or operator can document that the waste feed would not reasonably be expected to contain constituents listed in Part 261, Appendix VIII of this Chapter. Such documentation must be in writing and must be kept at the facility.

During start-up and shut-down of an incinerator, the owner or operator must not feed hazardous waste unless the incinerator is at steady state (normal) conditions of operation, including steady state operating temperature and air flow.

§265.346 [Reserved]

2. Waste Analysis

a. Summary of the Interim Final Regulation (§265.345)

As part of the waste analysis plan required by §265.13, the owner/operator must obtain a sample of each new waste to be incinerated and analyze it sufficiently to establish normal combustion conditions and the potential for emissions. At the minimum, this analysis must include heating value, halogen and sulfur content, and the concentrations of lead and mercury.

b. Comments on the Interim Status Standards

- o Waste analysis requirements place a heavy burden on manufacturers whose total waste stream will constantly vary. The requirement to constantly sample will be unmanageable. Suggest the requirement specify that analysis is required only if needed to establish steady state conditions.
- o Heating value testing for on-site incinerators which handle only a few wastes should not be required.
- o Amend 265.345(b) to read "organic halogen content." Inorganic halogens are not applicable to the emissions from hazardous waste incineration.
- o Add "...unless the owner or operator has written documented data that show that the element is not present at a level which will require post incineration treatment to meet the CAA standard."

c. Response to Comments on the Interim Status Standards

The comment on excessive testing when wastes are constantly varying is addressed in §265.13(b) (4). That standard allows the owner or operator to develop a sampling plan which specifies the frequency with which the analysis must be repeated along with the other parts of 265.13(b) which allow the owner or operator to determine the parameters to be tested, test methods and sampling methods. Thus, the Agency feels that owners or operators should be able to develop a testing program which is both reasonable and still provide information for the safe operation of incinerators.

The above argument also applies to on-site incinerators which will only receive a few relatively uniform wastes. To completely exempt these incinerators as suggested by a commenter,

from testing requirements such as heating value could allow highly variable wastes to be fed to the incinerator without the owner or operator's knowledge. The resulting upsets would cause unacceptable emissions from the incinerator.

The Agency feels that the comments regarding organic halogens and reference to the Clean Air Act are relevant. Further, in developing the general regulations for incineration the Agency re-evaluated the type of performance standards appropriate to incinerators and the waste analysis required to support those standards. As discussed in Part VI, those waste analysis requirements do not single out sulfur, lead, mercury, and halogens for analysis. Further, the Agency considered the extent to which the analysis for these substances would be used during the interim status period. The primary use appeared to be to gather information for possible regulations under the Clean Air Act. The Agency feels that such analysis can be required as a part of Clean Air Act permit issuance if it is needed.

In view of the above factors the Agency has dropped the specific requirements for analysis of sulfur, halogens, mercury, and lead from the interim status regulation. An analysis for all potential toxic components is included in the general standards where it will be used as a basis for application of specific performance standards.

The Agency is requiring an analysis of major hazardous constituents. This would include toxic organic constituents, including organic halogens and any constituents for which the waste is listed in Appendix VII of Part 261. An analysis for

metals is relatively simple and inexpensive. However, an analysis for organics can be more complex. The analysis is required on a "one time" basis for each major waste or typical waste mixture burned in the incinerator. The basis for the analyses is Appendix VII and as such very few organics are being sought in wastes. Sophisticated gc/ms analysis for organics are not generally required and more common gas chromatography techniques would normally be required. This is particularly true when a "history" of waste constituent have been developed for the wastes which the owner/operator commonly handles. These analyses are also inexpensive.

The Agency is requesting this analysis for two major reasons. First, the Agency feels that in order to establish conditions for proper and effective incineration, it is imperative that the owner or operator know the major hazardous constituents of a waste. Also, such information would be essential to respond to citizen complaints and to assess the possible cause of any damage to human health that may appear to be caused by the incinerator. Secondly, the Agency can use such information to establish priorities for issuing permits. The information obtained from the waste analysis will be necessary for the permitting process anyway, so requiring the analysis during interim status only moves up the timing of getting the information. The ultimate burden on the owner or operator is not greatly increased.

d. Final Language of the Interim Status Standard

\$265.341 Waste analysis

In addition to the waste analyses required by §265.13,

the owner or operator must sufficiently analyze a waste which he has not previously burned in his incinerator to enable him to establish operating conditions which will effectively destroy the waste and to determine the type of pollutants which might be emitted. At a minimum, the analysis must determine:

- a) the heating value of the waste,
- b) the presence of halogenated organics
- c) the presence of any other hazardous organic constituents for which the waste is listed in Part 261, Appendix VII.

[Comment: As required by §265.73, the owner or operator must place the results from each waste analysis, or the documented information, in the operating record of the facility.]

3. Monitoring and Inspection

a. Summary of the Interim Final Regulation

§265.347 The owner or operator must inspect (monitor):

- 1. existing combustion and emission control instruments and make appropriate corrections, to maintain steady-state combustion conditions at least every 15-minutes,
- 2. stack plume for normal appearance (opacity and color) at least hourly, and
- 3. the entire unit, daily, for leaks, spills, fugitive emissions, odors, and smoke.

b. Comments on the Interim Final Regulation

- 1. Object to specifying minimum time periods. Revise the regulation to allow owners or operators to establish monitoring and inspection based on best management practices, rather than previously defined requirements.

2. Assure that 15-minute monitoring allows continuous instrument monitoring.

c. Response to the Comments on Interim Final Regulation

The Agency disagrees with the first comment. No specific data base can demonstrate the wisdom of the 15-minute frequency. However, it is based on the Agency's generalized engineering expertise and the specific knowledge of incinerator operations gained in test burns conducted in 1975 and 1976. In many cases more frequent inspections may be required to detect and make appropriate corrections. The inspection interval for any parameter should really be based on knowledge of the specific incinerator system and how rapidly changes can occur. However, in interim status, when there will be little contact between the Agency and the facility, it is necessary to have a clearly defined time period which sets a threshold of compliance.

The regulation allows continuous monitoring as suggested in the second comment.

In view of these factors, the Agency decided that changes to the interim final regulation was not required.

d. Final Language of the Interim Status Standard

§265.347 Monitoring and inspections

The owner or operator must conduct, as a minimum, the following monitoring and inspections when incinerating hazardous waste:

- (1) Existing instruments which relate to combustion and emission control must be monitored at least every 15 minutes. Appropriate corrections to maintain steady state combustion conditions must be made immediately either automatically or by the operator. Instruments which relate to combustion and emission control would

normally include those measuring waste feed, auxiliary fuel feed, air flow, incinerator temperature, scrubber flow, scrubber pH, and relevant level controls.

- (2) The stack plume (emissions) must be observed visually at least hourly for normal appearance (color and opacity). The operator must immediately make any indicated operating corrections necessary to return visible emissions to their normal appearance.
- (3) The complete incinerator and associated equipment (pumps, valves, conveyors, pipes, etc.) must be inspected at least daily for leaks, spills, and fugitive emissions, and all emergency shutdown controls and system alarms must be checked to assure proper operation.

4. Closure

a. Summary of the Interim Final Regulation §265.351

At closure all hazardous waste and their residues (ash, scrubber water, scrubber sludge, etc.) must be removed from the incinerator.

b. Comments on the Interim Final Regulation

The Agency did not receive any comments on this section.

c. Response to Comments on the Interim Final Regulation

None.

d. Final Language of the Interim Status Standard

[§§265.348 - 265.350 Reserved]

§265.351 Closure [Interim Final]

At closure, the owner or operator must remove all hazardous waste and hazardous waste residues (including but not limited to ash, scrubber waters, and scrubber sludges) from the incinerator.

[Comment: At closure, as throughout the operating period, unless the owner or operator can demonstrate, in accordance with §261.3(c) or (d) of this Chapter, that the residue removed from his incinerator is not a hazardous waste,

the owner or operator becomes a generator of hazardous waste and must manage it in accordance with all applicable requirements of Parts 262, 263, and 265 of this Chapter.1

5. Other Comments

The Agency received a limited number of comments during the May 19, 1980 to July 19 comment period which addressed issues not related to the specific requirements of the Subpart - O interim status standards. Since the interim final comment period was only open to receive comment on the ISS standards the Agency has not responded to these comments here. The issues raised had been raised in comments on the December 18, 1978 proposed regulations and thus are adequately addressed in Part VI.

E. Text of Final Interim Status Standards

Subpart O - Incinerators

§265.340 Applicability

(a) The regulations in this Subpart apply to owners or operators of facilities that treat hazardous waste in incinerators, except as §265.1 and paragraph (b) of this Section provide otherwise.

(b) Incineration of wastes which:

- (1) Meet only the ignitability characteristic under Part 261, Subpart C, of this Chapter, or
- (2) Are listed in Part 261, Subpart D, of this Chapter for ignitability only (Hazard Code I)),

are exempted from the requirements of this Subpart, except §265.351, if the owner or operator can document that the waste feed would not reasonably be expected to contain constituents listed in Part 261, Appendix VIII of this Chapter. Such documentation must be in writing and must be kept at the facility.

§265.341 Waste analysis

In addition to the waste analyses required by §265.13, the owner or operator must sufficiently analyze a waste which he has not previously burned in his incinerator to enable him to establish operating conditions which will effectively destroy the waste and to determine the type of pollutants which might be emitted. At a minimum, the analysis must determine:

- a) the heating value of the waste,
- b) the presence of halogenated organics
- c) the presence of any other hazardous organic constituents for which the waste is listed in Part 261, Appendix VII.

[Comment: As required by §265.73, the owner or operator must place the results from each waste analysis, or the documented information, in the operating record of the facility.]

§§265.342 - 265.344 [Reserved]

§265.345 General operating requirements

During start-up and shut-down of an incinerator, the owner or operator must not feed hazardous waste unless the incinerator is at steady state (normal) conditions of operation, including steady state operating temperature and air flow.

§265.346 [Reserved]

§265.347 Monitoring and inspections [Interim Final]

The owner or operator must conduct, as a minimum, the following monitoring and inspections when incinerating hazardous waste:

- (1) Existing instruments which relate to combustion and emission control must be monitored at least every 15 minutes. Appropriate corrections to maintain steady state combustion conditions must be made immediately either automatically or by the operator. Instruments which relate to combustion and emission control would normally include those measuring waste feed, auxiliary fuel feed, air flow, incinerator temperature, scrubber flow, scrubber pH, and relevant level controls.
- (2) The stack plume (emissions) must be observed visually at least hourly for normal appearance (color and opacity). The operator must immediately make any indicated operating corrections necessary to return visible emissions to their normal appearance.
- (3) The complete incinerator and associated equipment (pumps, valves, conveyors, pipes, etc.) must be inspected at least daily for leaks, spills, and fugitive emissions, and all emergency shut-down controls and system alarms must be checked to assure proper operation.

[§§265.348 - 265.350 Reserved]

§265.351 Closure

At closure, the owner or operator must remove all hazardous waste and hazardous waste residues (including but not limited to ash, scrubber water, and scrubber sludges) from the incinerator.

[Comment: At closure, as throughout the operating period, unless the owner or operator can demonstrate, in accordance with §261.3(c) or (d) of this Chapter, that the residue removed from his incinerator is not a hazardous waste, the owner or operator becomes a generator of hazardous waste and must manage it in accordance with all applicable requirements of parts 262, 263, and 265 of this Chapter.]

[§§265.352-265.369 Reserved]

V. CONCEPT OF BEST ENGINEERING JUDGEMENT IN FINAL REGULATIONS

A. Conceptual Approach to the Final Standards Incorporating BEJ

A number of the comments on the proposed regulations followed a common theme, which resulted in a change in the basic approach to the regulation of incineration. Commenters opposed two basic facets of the proposed regulations as being too inflexible: 1) universally applicable, specific design and operating requirements, and 2) performance requirements that did not allow variances. As described in Part III of this document, the proposed regulations included specific operating requirements for temperature, dwell time (burn time in the combustion chamber), and quantity of excess air, as well as performance requirements for combustion and destruction efficiency and removal of halogens. Addressing one or more of these requirements, commenters consistently argued that these standards - particularly those dealing with operating requirements - did not provide sufficient flexibility to account for the many differences in wastes and incinerator designs. The performance standards were criticized as not reflecting any difference in the character of waste being burned or the design of the incinerator.

The Agency concluded that these comments had merit. The differences in wastes and incinerator designs argue that operating requirements can be more effectively established on a case-by-case basis than in a national regulation. The final regulations no longer include nationally applicable design and operating standards, but rely instead on a performance standard. The

performance standard will serve as a basis for setting operational requirements on a case-by-case basis.

Some flexibility to tailor operating or performance standards on a case-by-case basis can better ensure protection of human health and at the same time avoid overly protective requirements. The determination of how to regulate that flexibility and manage its implementation through the permit program requires additional analysis. EPA is today proposing a procedure for allowing the performance standard to be flexible by allowing for variances in a proposed addition to the performance standard. Application of that variance, as well as design and operating requirements as proposed, will be determined on a case-by-case basis. Thus, EPA anticipates establishing final standards which will provide flexibility for case-by-case tailoring of regulatory requirements to the specific wastes and incinerator in question, based on the best engineering judgement of the permitting official.

Best engineering judgment, as used in the context of the incineration standards, is little more than an acknowledgment that case-by-case judgements, based on site-specific circumstances need to be applied in establishing the permitting requirements applicable to an incinerator. This judgement is exercised within the constraints of criteria described and factors specified in the regulation. In making such judgements the permitting official should have as input comprehensive, up-to-date information on incineration technology and the thermal destruction characteristics of wastes, as well as any process or site specific information which he may require from the permit applicant.

Along with the regulations guidance manuals are being provided for this purpose. These include: "Permit Writer Guidelines for Hazardous Waste Incineration" and "Engineering Handbook for Hazardous Waste Incineration". Guidance will be updated regularly.

B. Application of Best Engineering Judgement in the Final Regulation

The opportunity for a permitting official to exercise best engineering judgement within the context of the incineration regulations occurs primarily in five basic areas, each of which is described more fully in Part VI of this document:

- (1) Designation of the principal organic hazardous components in the waste stream(s), to which the 99.99% DRE performance standard applies. This determination will be based on data from waste analysis and trial burns, utilizing criteria established in the regulation.
- (2) Designation of operating conditions in the permit, including CO level in the exhaust waste feed rate, combustion temperature, and air feed rate to the combustion system, as well as acceptable variations in the composition of the waste feed. The primary aspect of judgement is the determination of acceptable ranges for these parameters, since the basic operating conditions are determined in the trial burn based on the achievement of the performance standard. Perhaps the major area of judgement is the range of wastes that can be burned within a given set of permit conditions.
- (3) Determination of whether to grant a waiver from the requirement for a trial burn. This judgement is based on whether the data provided by the owner or operator in lieu of a trial burn is sufficient to determine compliance with the basic performance standard and to

establish operating conditions associated with meeting that standard. This judgement is closely related to the judgement of the range of wastes that can be burned at a given set of permit conditions.

The proposed additions to the final performance standards will require the additional application of Best Engineering Judgement (see the Background Document for the proposed additions to Subpart O specifically 264.343 (d-g)).

The timing and procedures for making each of these determinations is described below in the sequence in which they occur in the process of permit application and issuance.

Step 1 - Trial Burn Plan/Trial Burn Waiver

Before a new permit can be issued or a permit modification made for burning a waste either a trial burn must be conducted or data in lieu of a trial burn must be submitted to the Regional Administrator as a portion of Part B of the facility's permit application by the owner or operator. Thus, the owner or operator will submit either:

- 1) a trial burn plan, or
- 2) data in lieu of a trial burn plan that would provide substitute information to that normally obtained in the trial burn.

In the case of unpermitted facilities, this information would be submitted along with Part B of the permit application also. For facilities already permitted the trial burn plan or data would be submitted for approval, along with a request for a permit

modification to be based on the trial burn (or alternate data submitted). A trial burn permit in accordance with §122.27(b) is required to conduct the trial burn.

Either of these actions requires the engineering judgement of the permit writer. In making a judgement of the POHC's in the waste, the permitting official will use as a data base the detailed waste analysis submitted with either the trial burn plan or the request for a waiver and will base a judgement on the following criteria:

- (1) For a listed hazardous waste in Part 261 one or more organic constituents specified in Part 261, Appendix VII for which the waste is listed will be designated as a POHC.
- (2) Others will be designated based on:
 - (i) The degree of difficulty of incinerating the component. Organic waste constituents which represent the greatest degree of difficulty of incineration considering required temperature, excess air, and other burn-related parameters will be those most likely to be designated as POHC's.
 - (ii) Quantity or proportion of a constituent in a waste. Constituents are more likely to be designated as POHC's if they are present in larger quantities or proportions.

In addition to designation of POHC's the permitting official must assess the adequacy of the test burn protocol (operating

conditions, number and duration of burns), monitoring procedures, and environmental controls. The permitting official may use guidance documents (Permit Writers Guidelines for hazardous Waste Incineration; Engineering Handbook for Hazardous Waste Incineration) to guide his assessment of the trial burn plan. After requiring any necessary modifications, the trial burn plan will be approved, and the burn can be performed without a permit modification.

If a trial burn waiver has been requested, the permitting official will determine whether the performance standard of §264.343 (99.99% DRE) can be met for the POHC's in the waste and whether operating conditions necessary to meet that standard can be defined and met. This determination will be made by assessing the following information:

- (1) Physical properties and chemical composition of the waste for which a waiver is requested, compared with other wastes for which documented trial or operational burn data are available. The greater the similarity to a successful burn the greater the probability that a waiver will be granted.
- (2) Design of the incinerator unit to be used compared to that for which comparative burn data are available including planned operating schedules, burning rates, engineering reports, and pertinent drawings. The greater the similarity, the greater the probability of a waiver.
- (3) Existing incineration data for the same or similar

hazardous waste (in terms of physical and chemical characteristics) for the same or similar incinerator, or from other sources (e.g., pilot-scale incinerator data) which might be applied to the owner or operator's incinerator to demonstrate compliance. The data should identify the operating conditions required to achieve that performance. Again, the greater the similarity, the greater the probability of a waiver.

- (4) Such other information as the Regional Administrator finds necessary to determine compliance with §264.343 or to specify operating requirements under §264.345.

Step II - Trial Burn

During the trial burn, monitoring of waste feed rate and operating conditions, along with sampling and analysis of exhaust gases and ash, produces data which the permitting official will use to assess the performance of the incinerator. From these data direct calculations of the destruction and removal efficiency (DRE) are possible, and the operating conditions associated with it are directly measured. In many cases, the operating conditions will be varied during the trial burn to provide measurements of DRE at different operating conditions.

In addition to measuring POHC's in the exhaust gas, samples of the exhaust gases will be analyzed for by-products, metals, and hydrogen halides. These data will provide the permitting official with additional information with which to evaluate the capability of the proposed system to consistently and effectively meet the requirements of §264.343.

VI. RESPONSE TO COMMENTS/RATIONALE FOR THE FINAL REGULATION

The rationale for the final incineration regulation is presented in this section. The section is organized by subject, each subject corresponding to a major provision of the final regulation. The subjects are presented in the order that these provisions appear. Each subject discussion has five parts: (1) a summary of the proposed standard (if any) corresponding to, or most closely associated with the final standard, (2) comments received on the proposed standard, (3) response to the comments, (4) rationale for the final standard, and (5) final regulation language.

Preceding this provision-by-provision discussion of the final regulation is a summary and discussion of the general comments received on the proposed regulations.

A. General Issues

1. Summary of Comments

General comments received on the proposed §250.45-1 regulations are as follows:

- a. Incineration should be regulated three ways: emissions should be controlled by the Clean Air Act, effluents by the NPDES system, and land disposal by Subtitle D of RCRA. Legislative history does not indicate that Section 3004 "disposal" was intended to include incineration.
- b. Design and operating regulations are a mistake. The owner or operator should be allowed to determine how to operate the process in order to meet performance standards.
- c. RCRA incinerator standards should be waived for existing State permitted incinerators.

- d. EPA should allow incineration of many hazardous wastes if alternatives for treatment and disposal are economically or technically infeasible or cost of transportation is greater than incineration costs.
- e. Cement kilns and industrial boilers should comply with incinerator standards.

2. Analysis of and Response to General Issue Comments

Hazardous Waste Incineration Falls Within the RCRA Statute.

The commenters' discussion of whether hazardous waste incineration falls within the Section 1004(3) definition of "disposal" is irrelevant. The Agency is regulating incineration as "treatment" of hazardous wastes. Section 1004(34) defines treatment:

- (34) The term "treatment", when used in connection with hazardous waste, means any method, technique, or process, including neutralization, designed to change the biological character or composition of any hazardous waste so as to neutralize waste and render it non-hazardous, safe for transport, amenable for recovery, amenable for storage, or reduced in volume. Such term includes any activity or processing designed to change the physical form or chemical composition of hazardous waste so as to render it non-hazardous.

As a process designed to render hazardous waste non-hazardous and reduced in volume, incineration certainly falls within this definition. The Agency's statutory mandate to regulate such treatment processes is then found in Section 3004, which requires that the Administrator promulgate performance standards for the treatment of hazardous wastes. This mandate also serves the objectives of the statute, defined by Congress in Section 1003(4) as, among other things, "regulating the treatment...of hazardous wastes which have adverse affects on health and the environment". In addition, incineration of hazardous wastes was discussed

extensively in EPA's 1974 Report to Congress: Disposal of Hazardous Wastes, a document that strongly influenced Congressional development of RCRA and in testimony before Congressional Committees prior to passage of the 1980 amendments to RCRA. The Administrator's authority in the matter is made even more clear later in Section 3004, which says that standards set by the Agency "shall include, but need not be limited to, requirements respecting --

- (3) treatment...of all such wastes...pursuant to such operating methods, techniques, and practices as may be satisfactory to the Administrator."

The Agency disagrees with those commenters who suggested that the proposed regulations should be replaced by, or were in conflict with, the Clean Air Act. As discussed more fully in Part II of this document, current CAA regulations address only a fraction of the potential emissions from a hazardous waste incinerator. The Clean Air Act is oriented toward control of emissions on a pollutant-by-pollutant basis, and current regulations are focused largely on wide-spread, large-volume, pollutants (particulates, NO_x, SO_x, etc). In contrast, the pollutants which could be emitted from hazardous waste incinerators are more numerous and diverse. Many are acutely toxic or carcinogenic. A case-by-case, chemical by chemical, regulatory approach under the Clean Air Act is not practical in this situation. RCRA provides authority to control emissions broadly through destruction and combustion performance standards and direct operating and design standards. Such a regulatory approach is necessary in order to adequately

protect public health as required by RCRA. However, to the extent that standards can be developed in the future under the Clean Air Act to deal with specific hazardous air emissions, this may aid in the task of regulating hazardous waste incineration. Finally, disposal of ash or other residues generated by an incinerator or by other means must be done in compliance with RCRA regulations

b. Performance Standards are an Appropriate Approach

The response to this issue was discussed in Part V of this document, and is further discussed in response to some of the more specific comments which follow. As these responses indicate, the Agency agrees with the commenters and has incorporated a performance, rather than an operating and design standard in the final regulation.

c. Exempt Incinerators with State Permits

There is no reason why existing incinerators which currently hold State issued permits should be exempted from RCRA coverage. On the contrary, Congress intended that EPA establish uniform national standards to protect human health and the environment. All States which elect to run a RCRA hazardous waste program are required by RCRA to have standards at least as strict as the Federal Standards. In States which do not implement the RCRA program, the RCRA regulations are independently enforceable by EPA. Thus, existing as well as new incinerators will have to meet the new RCRA standards at a minimum.

4. Economic Considerations

The RCRA requires that EPA promulgate regulations for management of hazardous waste which will protect human health and

the environment. Thus, all regulations are designed to accomplish this objective. It is a fact that the requirements do impose significant costs which will affect the decision of hazardous waste generators in selecting among the various treatment, storage and disposal options. EPA evaluates the costs of alternative management approaches as a part of the overall RCRA economic analysis. Incineration will remain economically competitive with landfill. This is true because the total costs of waste management includes transport, long term maintenance of storage and landfill sites, and final disposal at the end of the useful life of landfills. Incineration constitutes ultimate disposal. Incineration of hazardous wastes now is clearly cheaper than incurring the long term costs in addition to unknown final disposal costs. The decision to incinerate hazardous waste versus applying other treatment, storage, and disposal options will be up to the generator or disposer within the constraints of technical and economic feasibility. However, each of the management options, as the RCRA statute mandates, will be required to meet the requirements of the regulations to ensure protection of human health and the environment.

5. Cement Kilns and Industrial Boilers

"Incinerator" is defined in Part 260 (45 FR 33074, May 19, 1980) as a device, "the primary purpose of which is to thermally break down hazardous waste." Part 261 (45 FR 33120) specifies that solid wastes which are beneficially used or reused or legitimately recycled or reclaimed are not regulated under the incineration provision of Part 264. In most cases cement kilns and

boilers would typically come within the exclusion defined in Part 261. Thus, these facilities are not currently subject to regulation. However, the Agency is further evaluating these to determine the need for regulation. The Agency expects to promulgate regulations to deal with specific types of hazardous waste recovery in the future if these investigations indicate a need to regulate such processes.

B. Exemption of Ignitable Waste

1. Summary of proposed regulation

Ignitable wastes were given no special mention in the proposed incinerator regulations.

2. Comments on the proposed regulation

- o Wastes which are hazardous due to only to ignitability should be exempt from the destruction efficiency and related requirements since they pose no toxicity hazard. Some of these wastes could be used as auxiliary fuel in burning other hazardous waste.

3. Response to comments

The Agency agrees with the comment. Incinerators burning wastes which are found to be hazardous based on ignitability only need not comply with Subpart O technical standards. The "ignitability only" determination may be based (a) a listing in Part 261 Subpart D for ignitability only, or (b) testing by the generator.

4. Rationale for the final regulation

EPA has decided to provide an exemption from most of the incineration regulations for wastes which are ignitable only if the permit applicant can demonstrate that these wastes do not contain hazardous constituents listed in Part 261, Appendix VIII.

The decision is based on two factors:

- (1) materials meeting these definitions are expected to combust easily merely by introduction of sufficient heat to initiate combustion. A very high destruction and removal efficiency is expected;
- (2) since they do not emit gases which are toxic, (otherwise they would be listed for toxicity) release of their combustion products should be of minimal environmental or health concern.

This exemption is conditional on a permit application showing that hazardous waste constituents listed in Part 261, Appendix VIII are not present. A conditional exemption is necessary because wastes could contain toxic constituents even though they fail only the ignitability characteristic. Since toxicity is not addressed in any of the hazardous waste characteristics (except for six pesticides included in the EP toxicity test) a waste could fail only the ignitability characteristic but still contain toxic organic constituents. Similarly, it is possible that specific samples of a waste listed for ignitability only, may contain (at least in some instances) toxic constituents which were not known to the Agency.

Based on the waste listing in the May 19, 1980 regulations (45 FR at 33123) the variance should apply to the following wastes when it can be demonstrated that they contain no Appendix VIII constituents: the spent non-halogenated solvents, xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, n-butyl alcohol, cyclohexanone, and the still bottoms from the recovery of these solvents.

It should be noted that incinerators which qualify under this exemption will still have to be permitted and comply with all other parts of the hazardous waste regulations even though they are exempted from the technical requirements of Subpart O.

5. Final regulatory language

\$264.340 Applicability

(a) The regulations in this Subpart apply to owners and operators of facilities that incinerate hazardous waste, except as §264.1 provides otherwise.

(b) If the Regional Administrator finds, after an examination of the waste analysis included Part B of the applicants permit application, that the waste to be burned,

- (1) is either (i) listed as a hazardous waste in Part 261, Subpart D, of this Chapter only because it is ignitable (Hazard Code I) or, (ii) that the waste has been tested against the characteristics of hazardous waste under Part 261, Subpart C, of this Chapter and that it meets only the ignitability characteristic; and
- (2) that the waste analysis included with Part B of the permit application includes none of the hazardous constituents listed in Part 261, Appendix VIII,

then the Regional Administrator may, in establishing the permit conditions, exempt the applicant from all requirements of this Subpart except §264.341 (Waste Analysis), and §264.351 (Closure).

(c) The owner or operator of an incinerator may conduct trial burns, subject only the requirements of §122.27(b) (Trial Burn Permits).

C. Special Requirements for Trial Burns

1. Summary of proposed regulations

No provisions in the proposed regulations indicated that incinerators were exempt from any parts of the incinerator standards during trial burns.

2. Comments on the proposed regulation

- It may not be possible to meet the performance and operating standards during a trial burn, since the purpose of the burn is to establish the feasibility of meeting those requirements.
- The full permitting process should not be required for a trial burn because it will require too much processing time and could stifle use of the incineration option.

3. Response to comments

The Agency concurs with these comments.

4. Rationale for the Final Regulation

It was not the Agency's intent in the proposed regulations that trial burns comply with all of the incinerator standards, since as the commenter noted, the trial burn is intended to determine whether, and under what conditions, those standards can be met. Further, the Agency has decided that a formal permit action to conduct a trial burn is unnecessary and could delay effective hazardous waste incineration. There are several reasons for this decision:

- a) trial burns will be of short duration

- b) trial burn operating conditions will be very closely controlled and monitored
- c) lengthy and costly permit procedures could delay prompt disposal of hazardous wastes
- d) excessive trial burn requirements could discourage use of the incineration option for "new" wastes which had not previously been burned

Nevertheless, the Agency believes that prior notice and approval is necessary for each trial burn. The final regulations provide a mechanism for this approval by requiring a trial burn plan prior to conduct of a burn (See paragraph L.). Thus, the Agency has clarified both of these points in the final regulation.

5. Final Regulatory Language

§264.344 New Wastes: trial burns or permit modifications

(a) The owner or operator of a hazardous waste incinerator may burn only wastes specified in his permit and only under operating conditions specified for those wastes under §264.345, except:

- (1) In approved trial burns under §122.27(b) of this Chapter; or
- (2) Under the exemptions created by §264.340.

D. Destruction and Removal Efficiency

1. Summary of Proposed Regulations

The proposed rules required that the incinerator be designed, constructed and operated to maintain a destruction efficiency of 99.99 percent as defined in the following equation:

$$DE = \left(\frac{W_{in} - W_{out}}{W_{in}} \right) \times 100, \text{ where}$$

DE = destruction efficiency

W_{in} = mass feed rate of principal toxic components of waste going into the incinerator

W_{out} = mass emissions rate of principal toxic components in waste in the incinerator combustion zone

2. Comments on the Proposed Regulation

Calculations for DE are not possible because:

- (a) The operator may not know the mass feed rate of the principal toxic components,
- (b) Sampling of the incinerator combustion zone is not technically feasible. In addition, time and space variations of the non-homogeneous turbulence conditions in the combustion zone would preclude obtaining any statistically meaningful results.

The term W_{out} should represent "Emissions to the Atmosphere" (where they can be measured).

The DE equation is inapplicable to metals or other noncombustible components which may also exit the combustion zone in exhaust gases but still not be destroyed.

A 99.99% DE has not been demonstrated technologically feasible for chemical waste incinerators.

To meet the unrealistically high DE level of 99.99%, many wastes would have to be burned with 90% or more supplementary fuel.

It is extremely difficult to obtain a DE of 99.99% while incinerating aqueous wastes containing less than 5% organics.

In the definition of the terms which are used in the DE calculation, it is unclear whether "principal" refers to weight, volume, or degree of hazard.

DE should not be set at an arbitrarily selected value of 99.99%, but should be variable and should bear some relationship to the degree of hazard of a particular waste.

Excursions from the specified DE should be allowed for operational variations.

EPA should develop test methods for W_{in} and W_{out} .

- DE must be performed on a statistical basis, specifying averages and appropriate confidence limits. Presently the calculation permits a single sample under best operating conditions.
- Mass emission levels should be set using OSHA standards for chemicals in the air.
- The following comments were offered related to the EPA incinerator test work (EPA-69-01-2966) program:
 - 1) does not support proposed temperature and residence time criteria,
 - 2) indicates that DE can be achieved when departing from the proposed combustion criteria,
 - 3) indicates that specific emission control equipment may not be needed for cement kilns burning wastes, and
 - 4) indicates pyrolysis methods may merit more study if DE is determined following the afterburner.
- EPA must define combustion temperature and retention time to apply the time/temperature/excess oxygen requirements.

3. Response to Comments

Calculations of Destruction Efficiency. The commenter who said that destruction efficiency calculations are not possible because the operator may not know the mass feed rate of principal organic hazardous components is in error. During normal operation, the concentrations may not be known with precision, although the feed rate of the waste should be easily measured and the approximate concentrations of the principal hazardous components should be known from the analysis of the waste required by the regulations. However, the final regulations do not require that destruction and removal efficiency be continuously monitored. Instead it is measured during a trial burn and, from the trial burn, incinerator operating conditions are established which can be quickly and easily monitored during normal operation. Subsequently, the

operator must accurately know the feed rate of the principal organic hazardous constituent(s) (by measurement) in order to compute the value of the DRE. By laboratory analysis the concentration of POHC's in the waste to be burned will be known, and the feed rate of that waste can be measured during the trial burn and during normal operation with conventional equipment and instruments.

EPA agrees with the commenter that sampling of the gas in the hot zone of incinerators is difficult technically and could lead to significant inaccuracies. In response, the definition of W_{out} in the final regulation has been changed to specify sampling of incinerator gases after scrubbing and cooling and before emission to the atmosphere. This change in definition of W_{out} also requires that Destruction Efficiency be renamed Destruction and Removal Efficiency (DRE) to reflect total removal of the principal hazardous components in the incinerator system. This change in definition allows sampling of emissions at a lower temperature than the combustion zone and simplifies sampling and analysis of gaseous emissions. The change to DRE also satisfies the comment that W_{out} represent emission to the atmosphere. The change to the use of the DRE has two major advantages to owners and operators of incinerators:

- 1) Sampling to determine compliance with the DRE will be easier and less costly, and
- 2) Credit for removal of any air pollution control equipment is included since the measurement is prior to release to the environment.

Destruction efficiency for metals. EPA agrees with the comment that the destruction efficiency defined in the proposed regulations, is not applicable to metals or other noncombustible components. Destruction and removal efficiency could be applicable to metals because it considers removal of waste constituents in the air pollution control system. Thus, metals which do not combust, could be controlled to a given removal level. (Waste constituents which come out in the incinerator bottom ash, as will be the case with many metals, are also considered removed, since they are not included in the term "W_{out}" in the destruction and removal efficiency equation:

$$DRE = \left(\frac{W_{in} - W_{out}}{W_{in}} \right) \times 100$$

Thus, conceptually, destruction and removal efficiency could be applied to metals. However, the Agency is not now applying the DRE standard to metals in the regulation at this time. Most importantly, this is because the Office of Solid Waste has no test data to show that a 99.99% DRE or any other specific value can be achieved. All of the Agency's incinerator trial burn data focused on organic constituents. Metals may exit an incinerator in the bottom ash, as particulates large enough to be collected in particulate removal equipment, as sub-micron size particulates which are not readily removed, and as vapors, in the case of some metals such as mercury. Thus, although removal efficiency for metals could be established, the Agency does not now know what level of removal is feasible for a national regulation. The Agency intends to undertake investigation

of this issue and specifically solicits comments and data on metal removal efficiency.

The definition of DRE in the final regulation has been changed to specify the term Win as "principal organic hazardous component(s) in the waste stream feeding the incinerator."

Destruction efficiency of 99.99%. The comment that a 99.99% DE has not been demonstrated is in error. The achievability of a 99.99% destruction efficiency has been demonstrated and is a major element in the Agency's rationale for including it in the final regulation. This is discussed thoroughly in paragraph 4, "Rationale", below.

Supplementary Fuel. The Agency realizes that supplementary fuel will be required to destroy some wastes, including "aqueous wastes with 5% or less organics". This would be the case regardless of the level of DRE. The Agency believes that protection of human health requires that even wastes which have a very low heat value must be adequately destroyed, even when it increases operating costs and fuel consumption.

Definition of principal component. The Agency agrees with the comment that the definition of "principal" may have been unclear. The final regulations describe the criteria and procedures for selecting "principal" hazardous components. The decision identifying one or more principal organic hazardous components will be made by applying the best engineering judgement of the permit writer based on criteria specified in the regulation.

DE should be variable. The Agency agrees in theory with the comment that DE (DRE) should be variable. Such a variance however,

would have to be based on a careful case-by-case analysis. The Agency is today proposing a procedure which will allow the permit writer to either increase or decrease the required DRE value based on an assessment of the impact on human health and the environment. It should be made clear that in the absence of convincing evidence that a lower level of DRE is safe, EPA will require that the owner or operator comply with the minimum DRE of 99.99%.

Excursions from DE. Because it would result in stack emissions that could be hazardous, the Agency disagrees in principle with the comment that excursions be allowed from the 99.99% DRE. In actual practice the DRE will be directly measured only during trial burns or during occasional compliance testing. However, the operating conditions established in the permit for continuously monitored incinerator operating parameters, i.e., temperature, air feed rate, carbon monoxide in the stack, etc., are intended to prevent significant deviations from the stipulated DRE. Also activation of alarm systems and automatic incinerator shutdown is required if operating parameters exceed specified limits in the permit.

Calculation of DRE. The Agency agrees with the comment that a need exists to develop test methods for the determination of Destruction and Removal Efficiency. In fact this effort is under way and to date specific analytical techniques for waste analysis have been published in the EPA publication SW-846. The development of sampling methods for W_{out} , i.e., the stack, are continuing as an overall Agency effort not confined to just hazardous waste

incinerators. Specific guidance on currently available techniques being recommended by EPA can be found in the Engineering Handbook for Hazardous Waste Incineration (78). Discussion for computation of the DRE is presented in guidance (58).

Statistical Basis for DRE. EPA agrees with the comment that determination of performance standards should be statistically based. However, it is necessary to provide the most flexibility in conducting trial burns and particularly to minimize the burden of trial burns on owners and operators. Additionally, early in the regulatory history of implementing Subpart O, there will be very little data to support sophisticated statistical analyses. The Agency is building a data base which is described elsewhere and plans to use the latest statistical techniques to analyze all data as warranted by the character and quantity of available data.

Emission Limits (TLV). EPA agrees that OSHA standards have the potential to be used to set emission levels from hazardous waste incinerators. The Agency has thoroughly explored this approach and has developed a proposed methodology to apply the OSHA type threshold standards to incinerator emissions. The reader is referred to the Background Document on Proposed Variances to §264.343 Performance Standards for a comprehensive discussion of this approach.

The EPA Test Program. The Agency agrees with the four comments made on the results of its test work under Contract 68-01-2966. The test results do not adequately support the proposed combustion criteria. This is one of several reasons

that the Agency decided to drop the combustion criteria from the final regulations and establish the DRE as the operating standard. The second point is basically the same statement as the first and the Agency also agrees.

The Agency also agrees with the third comment that cement kilns burning hazardous waste will not likely have to add any additional air pollution control equipment. The Clean Air Act currently provides emission standards for normal cement kiln operation. Also the current RCRA standards exempt cement kilns burning hazardous wastes as a resource (heat value) recovery method.

The use of pyrolysis as a hazardous waste treatment method has merit and will certainly find its place in the range of waste management options. The Agency will study pyrolysis processes in the future and if a decision is made to regulate such processes, appropriate standards will be developed.

4. Rationale for the Final Regulation

a) Destruction and Removal Efficiency as a Conceptual Approach

The regulations for incinerators proposed in the December 19, 1978 Federal Register included two basic types of controls: (1) performance standards for destruction efficiency and combustion efficiency and (2) operating and design standards of minimum operating temperatures, retention times, etc. Operating requirements are included in the final regulation, but they are determined on a case-by-case basis and are derived from test data based on achieving the DRE. The rationale for dropping temper-

ature/time operating requirements is discussed in Part V and also in paragraph G below. As discussed in paragraph G, combustion efficiency has been dropped in the final regulation.

The Agency has found that destruction and removal efficiency is both a necessary and a supported performance standard for incineration. Other types of performance standards were considered and rejected during development of the proposed and final incineration regulations. For example, reliance on combustion efficiency was rejected as being infeasible. Establishing limits for air emissions from the stack was rejected because, as discussed in Part II of this document, it is infeasible to establish emission limits for the large number and mixtures of hazardous substances which could potentially be emitted.

The Agency considered defining technology requirements - for example, "best available technology" or "best practicable technology" as the terms are used in the Clean Air Act and Clean Water Act. This concept in essence involves a survey of all of the technology being used to control a specific pollutant or emission. The survey identifies the processes which are most advanced in meeting environmental goals. The Agency then promulgates a regulation which is based on across-the-board use of this technology.

The Agency has adopted in the DRE standard a modified type of best available technology approach. The 99.99 percent destruction and removal efficiency represents a "best available incinerator performance" that can be achieved on a broad range of wastes

using state-of-the-art technology and proper operating practices.

Thus, the Agency believes that a combination of a "best technology" performance standard of 99.99% DRE and if shown to be feasible, a risk assessment override to deal with exceptional cases, provides a practical standard consistent with the RCRA mandate to protect human health and the environment.

b) Achievability of 99.99% DRE

The Agency has found that a destruction and removal efficiency of 99.99% is an achievable standard for hazardous waste destruction. As shown in Table I, the Agency has identified 54 test burns carried out on a number of hazardous wastes. Of these 54 test burns, 45 achieved a destruction efficiency (DE) of 99.99% or better. Consideration was given to the additional removal achieved by air pollution control equipment (now allowed in the DRE calculation). The nine test burns that did not consistently achieve a minimum 99.99% destruction efficiency are discussed below.

1) The first U.S. based burn by the M/T Vulcanus occurred in 1974. (12) This burn took place in the Gulf of Mexico with chlorinated hydrocarbon waste from Shell Chemical Co. The destruction efficiency for the chlorinated hydrocarbons was 99.97% to 99.98% as shown in Table I. This lower destruction efficiency was caused, as verified later, by an inefficient burner design.

2) The destruction of solid DDT in the Palo Alto Multiple Hearth Sewage Sludge Incinerator achieved a DE of >99.97%. (14) This work in 1975 demonstrated that a multiple hearth sewage

TABLE I

Summary of Incinerator Destruction Efficiency Test Work

WASTE	INCINERATOR	LOCATION	DESTRUCTION EFFICIENCY (%) OF PRINCIPAL COMPONENTS & (PERCENT)	
Shell Aldrin (20% granules) ¹	Multiple Chamber	Midwest Research	Aldrin	>99.99
			Total Species	>99.99
Shell Aldrite ¹	Multiple Chamber	Midwest Research	Aldrin	>99.99
			Total Species	>99.99
Atrazine - liquid ¹	Multiple Chamber	Midwest Research	Atrazine	>99.99
			Total Species	>99.99
Atrazine - solid ¹	Multiple Chamber	Midwest Research	Atrazine	>99.99
			Total Species	>99.95
Para-Arsanilic Acid ²	Molten Salt Combustion	Rockwell Internat'l		>99.999
Captan - solid ¹	Multiple Chamber	Midwest Research	Captan	>99.99
			Total Species	>99.99
Chlordane 5% dust ³	Liquid Injection	TW	Chlordane	>99.99
Chlordane, 72% Emulsifiable Concentrate and No. 2 Fuel Oil ³	Liquid Injection	TW	Chlordane	>99.999
WASTE	INCINERATOR	LOCATION	DESTRUCTION EFFICIENCY OF PRINCIPAL COMPONENTS (PERCENT)	
Chlorinated hydrocarbons, trichloropropane, trichloroethane, and dichloroethane predominating ¹²	Two high temperature incinerators	M/T Vulcanus Ocean Combustion Services	Chlorinated Hydrocarbons	99.92 - 99.99
Chloroform ²	Molten Salt Combustion	Rockwell Internat'l	Chloroform	>99.999
DDT 5% Oil Solution ¹	Liquid Injection	TW	DDT	>99.99
DDT (solid) ¹⁴	Municipal Multiple Hearth Sewage Sludge Incinerator	City of Palo Alto	DDT	>99.970 - 99.99
DDT, 10% Dust ¹	Multiple Chamber	Midwest Research	DDT	>99.99
			Total Species	>99.99
20% DDT Oil Solution ³	Liquid Injection	TW	DDT	>99.99
DDT 25% Emulsifiable Concentrate ³	Liquid Injection	TW	DDT	>99.99
DDT 25% Emulsifiable Concentrate ¹	Multiple Chamber	Midwest Research	DDT	>99.99
			Total Species	>99.99 - >99.99

$$DE = \frac{W_{in} - W_{out}}{W_{in}} \times 100$$

Where:

W_{in} = mass feed rate of the principal toxic component
W_{out} = mass emission rate of the principle toxic component in the incinerator combustion zone

TABLE 1 (cont.)

WASTE	INCINERATOR	LOCATION	DESTRUCTION EFFICIENCY OF PRINCIPLE COMPONENTS (PERCENT)	
DDT Oil 20% emulsified DDT Waste Oil - 1.7% PCB ¹³	Thermal Oxidizer Waste Incinerator	General Electric Co.	DDT	99.9999
			PCB	>99.9921 - >99.9995
DDT Powder ⁴	Molten Salt Combustion	Rockwell Internat'l	DDT	99.999
Dieldrin 15% Emulsi- fiable Concentrate ³	Liquid Injection	TRW	Dieldrin	>99.999
Dieldrin - 15% Emulsifiable Concen- trate and 72% Chlordane Emulsifi- able Concentrates (mixed 1:3 ratio) ³	Liquid Injection	TRW	Dieldrin	>99.99
Diphenylamine-HCl ²	Molten Salt Combustion	Rockwell Internat'l	Diphenylamine	>99.999
Ethylene Manufacturing Waste ⁵	Liquid Injection	Marquardt Co.	Waste Con- stituents Total Organics	>99.999 99.95 - 99.96
GB (C ₄ H ₈ , C ₂ F ₂) ²	Molten Salt Combustion	Rockwell Internat'l	GB	>99.99999999 >99.99999976
WASTE	INCINERATOR	LOCATION	DESTRUCTION EFFICIENCY OF PRINCIPLE COMPONENTS (PERCENT)	
Herbicide Orange ¹⁹	Two Identical Re- fractory-lined furnaces	Ocean Combustion Services - M/T Vulcanus	2,4,5-T-2,4,D	>99.999 99.985 -
Hexachlorocyclopenta- diene ⁵	Liquid Injection	Marquardt Co.	Waste Con- stituents Total Organics	>99.999 99.94 - 99.95
Acetic Acid, Solution of Kepone ⁶	Rotary Kiln Pyrolyzer	Midland - Ross	Kepone	>99.9999
Toledo Sludge & Kepone co- incineration ⁶	Rotary Kiln Pyrolyzer	Midland - Ross	Kepone	>99.9999
Lindane, 12% Emulsi- fiable Concentrate ³	Liquid Injection	TRW	Lindane	>99.999
Malathion ²	Molten Salt Combustion	Rockwell Internat'l	Malathion	99.999 - 99.9998
Malathion, 25% Wet Power ¹	Multiple Chamber	Midwest Research	Malathion Total Species	>99.99 >99.99
Malathion 57% Emulsi- fiable Concentrate ¹	Multiple Chamber	Midwest Research	Malathion Total Species	>99.99 >99.98

TABLE I (cont.)

WASTE	INCINERATOR	LOCATION	DESTRUCTION EFFICIENCY OF PRINCIPLE COMPONENTS (PERCENT)	
Methyl Methacrylate (MMA) ⁵	Fluidized bed	Systems Tech	Waste Con- stituents	>99.999
			Total Organics	99.96 - 99.98
0.3% Nirex Bait ¹	Multiple Chamber	Midwest Research	Nirex	>98.21 - 99.98
			Total Species	>97.78 - 99.96
Mustard ²	Molten Salt Combustion	Rockwell Internat'l	Mustard	>99.999992 >99.999985
Nitrochlorobenzene ⁵	Liquid Injection	Rollins	Waste Con- stituents	>99.99 - 99.999
			Total Organics	99.84 - 99.87
Nitroethane ²	Molten Salt Combustion	Rockwell Internat'l	Nitroethane	>99.993
Phenol Waste ⁵	Fluidized Bed	Systems Tech	Waste Con- stituents	>99.99
			Total Organics	99.97 - 99.95
Picloram ¹	Multiple Chamber	Midwest Research	Picloram	>99.99
			Total Species	>99.63 - 99.99
Picloram (Tordon 10K pellets) ¹	Multiple Chamber	Midwest Research	Picloram	>99.99
			Total Species	>99.93 - 99.99
PCB's ⁸	Rotary Kiln	Rollins	PCB's	>99.999964 >99.999977
PCB Capacitors ⁷	Rotary Kiln	Rollins	Waste Constituents	99.5 - 99.999
			Total Organics	99.94 - 99.98
PCB ⁴	Cement Kiln	Swedish Water and Air Pollution Research Institute	PCB's	>99.9998
Polyvinyl Chloride Waste ⁹	Rotary Kiln	3 M Company	Total Organics	99.80 - 99.88
			Chlorinated Organics	99.99
Toxaphene 20% Dust ¹	Multiple Chamber	Midwest Research	Toxaphene	>99.99
Toxaphene 60% Emulsi- fiable Concentrate ¹	Multiple Chamber	Midwest Research	Toxaphene	>99.99
Trichlorethane ²	Molten Salt Combustion	Rockwell Internat'l	Trichlorethane	>99.99
2,4-D low volatile liquid ester ³	Liquid Injection	TIN	2,4-D	>99.99

TABLE I (cont.)

WASTE	INCINERATOR	LOCATION	DESTRUCTION EFFICIENCY OF PRINCIPLE COMPONENTS (PERCENT)	
2,4,5-T (Weedon TM) 14	Municipal Multiple Hearth Sludge Incinerator	City of Palo Alto, California	2,4,5-T	99.990 - 99.996
2,4,5-T _{10,11}	Single Hearth Furnace	Swedish Water and Air Pollution Research Institute	2,4,5-T	99.995
2,4,5-T ⁴	Single Hearth Furnace	Swedish Water and Air Pollution Research Institute	2,4,5-T	99.995
2,4,5-T ⁴	Single Hearth Furnace	Swedish Water and Air Pollution Research Institute	2,4,5-T	92
2,4,5-T ⁴	Single Hearth Furnace	Swedish Water and Air Pollution Research Institute	2,4,5-T	99.995
VX (C ₁₁ H ₂₆ O ₂ PSN) ²	Molten Salt Combustion	Rockwell Internat'l	Waste Constituents	>99.999989 - 99.9999945
Zinc ¹	Multiple Chamber	Midwest Research	Zinc	>99.99

sludge incinerator is not well suited for destruction of many hard-to-burn hazardous materials. It is now generally recognized in the technical community that multiple hearth incinerators are not well suited for complete destruction of hazardous wastes.

3) and 5) The two test results of DE = 99.99% for the destruction of a 20% DDT oil solution and a 15% Dieldrin/72% Chlordane concentrate mixture were performed in TRW's pilot scale incinerator (3). These test results were obtained during four pilot incinerator runs where the incinerator temperatures were all below 1550° F (845° C) or where less than the stoichiometric amount of air required was supplied. These results also reinforce the point that adequate temperatures and sufficient excess air are necessary to achieve high incinerator destruction efficiencies.

4) In an evaluation of the test work done on 25% DDT by Midwest Research, 20 test runs were made, with only one of the 20 yielding an efficiency of less than 99.99% for DDT destruction (1). The 20 experiments were done to develop a regression model to predict DDT destruction based on varying the injection rates of DDT, excess air rates, temperature, and air turbulence. Thus, destruction efficiencies of less than 99.99% were expected as part of the experiment. It is interesting to observe from the MRI work that the one result which yielded less than 99.99% efficiency also had the lowest retention time of all the experiments except for one run which had an identical retention time but a higher combustion temperature. Thus, this one experiment out of 20 reinforces the point that conditions must be adequate

and sufficient to ensure 99.99% DE, or higher, and when they are adequate, 99.99% DRE can be achieved.

6) Later Vulcanus burns, monitored by the U.S. EPA during 1977 and 1978 demonstrated that the Vulcanus could achieve a minimum of 99.99% destruction efficiency (19). The current International agreement on Ocean Incineration requires a minimum DE of 99.99%.

7) The report from Midwest Research Institute on the pilot scale burn of Mirex bait formulation, concluded that a higher temperature was needed to effectively destroy the pesticide to 99.99% efficiency (1). Gas temperatures of 590° C to 840° C were measured during the ten test runs reported. Mirex has a highly chlorinated structure ($C_{10}Cl_{12}$) which could indicate that a higher combustion temperature ($>1000^{\circ}C$) would adequately destroy the molecule.

8) One of the results reported for PCB containing capacitors burned at the Rollins Environmental Services incinerator showed a PCB destruction efficiency of 99.5%. The calculation included PCB residue left in the incinerator ash. The efficiency based on combustion gas sampling alone was in fact 99.999% (5). The reason the ash contained significant quantities of PCB's was that the capacitors for the test burn were not crushed before burning but were fed whole to the rotary kiln. A second test burn, using capacitors which were previously hammermilled, yielded a DE of 99.999% for PCB's even when the ash residues were considered in the calculation (5).

9) The one low destruction efficiency of 92% for 2,4,5-T reported by the Swedish Water and Air Pollution Research Laboratory occurred during an experiment with 2,4,5-T added to wood chips and sawdust (4). The report states that "However, when wood chips with a very high water content were burned under "open fire" conditions, the temperature in the flue gas duct was decreased temporarily to around 100° C and only 92% of I (2,4,5-T) was destroyed." (4) This one test was conducted at a very low combustion temperature and a low destruction efficiency would thus be expected. Other tests indicate that 2,4,5-T can be adequately destroyed (see Table 1).

In a number of tests results reported in Table 1, the DE of total organic species was less than the DE for the selected toxic organic. This would indicate that organic compounds (of undetermined type) were present in the burned mixture in larger quantity and were not destroyed to the same level as the selected organic. Complete analyses of the mixtures were not made to determine the full range of potential POHC's and no selection process was used to determine the most difficult constituents to burn. These are necessary steps required by Subpart O.

These tests represent all the data currently available to EPA through government reports, contractor studies and a search of the technical literature. In addition, EPA requested test data from a number of commenters and did receive a reply from the American Society of Mechanical Engineers. The ASME reply suggested that a 99.99% DE was not consistently achievable. However, the ASME data do support a DRE OF 99.99% (34). The

change from DE to DRE fortifies the achievability of the performance standard because DRE now specifically allows the removal obtained in air pollution control devices to be recognized in the performance of incinerators.

The data discussed above demonstrate the achievability of a 99.99% DRE. The test data in Table I do not include examples of a complete array of all wastes and waste mixtures which have been, or may be, incinerated.

In the final report which summarized the full scale incinerator test work conducted in 1975 - 1976, the contractor recommended that additional work be done on (1) organic phosphate compounds, (2) Fluorinated organic compounds, and (3) organic orthosilicate compounds (5). These classes of compounds were identified as being industrially important and potentially exhibiting different behavior in incinerators than those for which tests were conducted.

The Agency has been able to obtain test burn data on two phosphorous type organic compounds, Malathion (2), and VX(C₁₁H₂₆O₂PSN) (2). Both of these compounds were combusted in a molten salt incinerator with destruction efficiencies exceeding 99.99 percent (see Table 1).

The chemistry of combustion is extremely complex. The kinetics and thermodynamics involved depend on the combustion conditions and the physical/chemical properties of the material(s) being oxidized. For wastes the chemistry is further complicated by the variable compositions and matrices encountered.

Some general conclusions can however, be drawn despite the variations in composition and constituents that will result during combustion. Within this essentially exhaustless field of waste compositions there are specific substances which exhibit remarkable thermal stability. Polychlorinated biphenyls (PCBs) are an example of a class of compounds that are difficult to burn. The PCB molecule is stable because of its aromatic character. The breakdown of chlorinated aromatics form transition states which in turn can lead to combustion by-products (products of incomplete combustion). The combination of these two factors so affect the kinetics that combustion conditions found to destroy PCBs should be expected to destroy other industrial organic chemicals.

Since the results of the tests almost universally supported the achievability of a 99.99 percent destruction efficiency, the Agency concludes that a 99.99% destruction and removal efficiency is a feasible standard to apply on a national level in the regulation. Wastes which cannot be destroyed to the 99.99% DRE standard should not be burned.

c) Application of the DRE

The proposed regulation stated that the destruction efficiency was to be applied to the "principal toxic components" in the waste going to the incinerator. As noted above, comments were received questioning how this term was to be defined, and questioning the validity of applying the destruction efficiency requirement to metals.

The Agency has addressed these concerns in the regulation. First, the word "organic" has been added so that the term used in the regulation is "principal organic hazardous component". Conceptually, the change from DE to DRE should have overcome the concern about including non-organics in the DRE equation, since even if not combusted, materials, could be removed from the system by either being incorporated into the bottom ash or being collected with the particulates in the stack gas. The test burn data cited above did not include a determination of metals removal. The Agency has not yet compiled data to support either 99.99% or any other removal efficiency for metals. Thus, the DRE applies only to organics in the regulation.

In considering how to define principal organic hazardous components (POHC's), the Agency concluded that a case-by-case

determination based on specified criteria was the only reasonable approach. No single "across the board" definition stood up to scrutiny; for example, "component of greatest concentration", "component of greatest hazard", or "component most difficult to thermally destruct". These criteria were difficult to quantify or mold into a simple formula. Instead the Agency has defined appropriate criteria for application on a case-by-case basis by the permitting official using his best engineering judgement.

These criteria are as follows:

- (i) The degree of difficulty of incinerating the component. Organic waste constituents which represent the greatest degree of difficulty of incineration considering required temperature, excess air, and other burn-related parameters will be those most likely to be designed as POHC's or hazardous by-products.
- (ii) Quantity or proportion of a constituent in a waste. Constituents are more likely to be designated as POHC's or hazardous by-products if they are present in higher quantities or proportions.

In the Agency's judgement, these criteria define the characteristics of a waste component which relate to its potential to escape from the stack and cause damage to human health.

The Agency considered the matter of degree of hazard for potential application in Subpart O. See the Background Document on "Degree of Hazard", April 1980 which was prepared in support of the May 19, 1980 promulgation.

In the course of defining criteria for identifying POHC's the Agency recognized that during incineration some of the POHC's may be "destroyed" by breaking down or recombining into by-products. The "Engineering Handbook for Hazardous Waste Incineration"

contains examples of this phenomenon. Some of these by-products could be of equal or greater hazard than the POHC's from which they are formed. Thus, the Agency proposes to extend the application of the destruction and removal efficiency to these by-products (See Background Document for Proposed Subpart O Standards).

5. Final Regulatory Language

§264.342 Principal Organic Hazardous Constituents (POHCs)

(a) Principal Organic Hazardous Constituents (POHCs) in the waste feed must be treated to the extent required by the performance standard of §264.343.

(b) (1) One or more POHCs will be specified in the facility's permit, from among those constituents listed in Part 261, Appendix VIII of this Chapter, for each waste feed to be burned. This specification will be based on the degree of difficulty of incineration of the organic constituents in the waste and their concentration or mass in the waste feed, considering the results of waste analyses and trial burns or alternative data submitted with Part B of the facility's permit application. Organic constituents which represent the greatest degree of difficulty of incineration will be those most likely to be designated as POHCs. Constituents are more likely to be designated as POHCs if they are present in large quantities or concentrations in the waste.

(2) Trial POHCs are designated for performance of trial burns in accordance with the procedure specified in §122.27(b) of this Chapter for obtaining trial burn permits.

§264.343 Performance Standards

An incinerator burning hazardous waste must be designed, constructed, and maintained so that, when operated in accordance with operating requirements specified under §264.345, it will meet the following performance standards:

(a) An incinerator burning hazardous waste must achieve a destruction and removal efficiency (DRE) of 99.99% for each principal organic hazardous constituent (POHC) designated (under §264.342) in its permit for each waste feed. DRE is determined for each POHC from the following equation:

$$DRE = \left(\frac{W_{in} - W_{out}}{W_{in}} \right) \times 100\%$$

Where: W_{in} = Mass feed rate of one principal organic hazardous constituent (POHC) in the waste stream feeding the incinerator, and

W_{out} = Mass emission rate of the same POHC present in exhaust emissions prior to release to the atmosphere.

(b) An incinerator burning hazardous waste containing more than 0.5% chlorine must remove 99% of the hydrogen chloride from the exhaust gas.

(c) An incinerator burning hazardous waste must not emit particulate matter exceeding 180 milligrams per dry standard cubic meter (0.08 grains per dry standard cubic foot) when corrected for 12% CO₂, using the procedures presented in the Clean Air Act regulations, "Standards of Performance for Incinerators", 40 CFR 60.50, Subpart E.

(d) For purposes of permit enforcement, compliance with the operating requirements specified in the permit (under §264.345)

will be regarded as compliance with this Section. However, evidence that compliance with those permit conditions is insufficient to ensure compliance with the performance requirements of this Section may be "information" justifying modification, revocation, or reissuance of a permit under §122.15 of this Chapter.

E. Emissions of Halogens and Metals

1. Summary of the Proposed Regulation

EPA proposed in §250.45-1(e)(2) that a hazardous waste incinerator used to destroy hazardous waste containing more than 0.5 percent halogens must have an emission control device to remove 99% of the halogen from the exhaust. The proposed regulation dealt with control of metals through the performance requirement of 99.99 percent destruction efficiency.

2. Summary of Comments

- 99% removal of halogens is difficult and beyond the state-of-the-art particularly for hydrogen halides other than hydrogen chloride. A 95% removal is suggested as a more reasonable level.
- A single value of scrubber efficiency (SE) is not appropriate for all incinerators. It does not take into account large variations of the mass rate of halogen emissions, and possible impact on health or the environment.
- A more cost effective regulation would be based on a stack emission level which would then determine the technology needed.
- A case-by-case review in the absence of an absolute removal requirement will promote technology development.
- Although the technology for 99% removal may exist, EPA should establish a base emission rate below which the control of halogens is not necessary.

- The 0.5% halogen limit should apply to the total waste stream, not just the hazardous portion.
- Hydrogen chloride is much more easily removed than other hydrogen halides in scrubbers. The chemical forms of the halogens must be specified.
- Provide a variance to scrubber efficiency if the owner or operator can demonstrate that halogen emissions will not exceed levels promulgated in 29 CFR 1910.100 (OSHA).
- Establish a base level emission rate for hydrogen halides below which controls are not necessary.
- Higher combustion temperatures for halogenated aromatic hydrocarbon's make removal of hydrogen halides more difficult.

3. Response to Comments

There are a number of undesirable gaseous components which can occur in the exhaust gas from a hazardous waste incinerator. To a large extent the presence of these components will depend on the composition of the wastes which are burned; to a lesser extent, their presence will be dictated by combustion conditions (chiefly, temperature, turbulence, residence time, and excess air). The more common undesirable gaseous components include sulfur oxides, nitrogen oxides, hydrogen halides (HCL, HF, etc.), carbon monoxide (CO), and elemental halogens.

Since a large proportion of gaseous, liquid, and solid hazardous wastes are organic compounds containing chemically bound chlorine, gaseous hydrogen chloride (HCL) is a frequently occurring component that may be present in relatively high concentration in incinerator exhaust gases.

Certain scrubbers, such as packed towers, sieve plate scrubbers or spray tower are generally quite efficient in remov-

ing highly soluble or readily reactive gases, such as HCl. HCl is very soluble in water, and if the water is made alkaline by the addition of calcium oxide, calcium hydroxide, sodium hydroxide, sodium carbonate, etc., the removal ability of the scrubber is enhanced.

Scrubber efficiency for HCl removal is defined as follows:

$$\text{Eff.} = \frac{(\text{HCl}_{\text{in}} - \text{HCl}_{\text{out}})}{\text{HCl}_{\text{in}}} \times 100$$

where HCl_{in} = lbs. or kgs. of HCl entering the scrubber systems, per unit time.

HCl_{out} = lbs. or kgs. of HCl in scrubber exhaust gas, per unit time.

In the above definition for scrubber efficiency the term "scrubber system" is used, as opposed to the word "scrubber", since many incinerator facilities have a scrubber system, and rarely have only a single scrubber. A scrubber system is usually composed of a pre-scrubber quench section (to pre-cool the hot gases, and prevent excess evaporation of water), and one or more scrubbers installed in a series-flow arrangement. In some installations, the first is a venturi scrubber which eliminates most particulates and some of the acid gases. Subsequent scrubbers remove acid gases as their primary function. Residual water from the quench section is generally recycled to the quench or to one of the scrubbers. Thus, where the term "scrubber efficiency" is used, the acid gas removal efficiency of the whole scrubber system is usually the parameter being considered. The efficiency of individual scrubber units can be determined, but the efficiency for the total scrubber system is the fundamental parameter desired.

Since the gases exiting the scrubber are generally cool ($>180^{\circ}\text{F}$), sampling and analysis of this gas is comparatively easy and safe. Sampling of the hot incinerator exhaust gases is not simple and it may be a somewhat hazardous procedure. A more common basis for estimating " HCl_{in} " is to base this quantity on the waste feed rate to the incinerator and on the average organic chlorine analysis of this feed. This method is acceptable for purposes of Subpart O. This method may slightly overstate the true HCl content of the unscrubbed exhaust gas. Thus, the calculated value for scrubber efficiency may also be slightly overstated. The sources of error in using a calculated " HCl_{in} " value are as follows:

- a. Some chlorine may react with alkaline metal components of the feed, and end up in slag or fly-ash.
- b. Some chlorine may exit the combustion chamber in elemental form (Cl_2). Chlorine is not readily soluble in scrubber water, but some will react with alkaline components of scrubber liquid to form hypochlorites.

The remainder will exit the system via the stack.

Scrubber efficiency calculations should, therefore, take into account any chlorine which escapes in elemental form or as a metallic chloride. Stack sampling and analysis procedures found in guidance take this into account.

Results of Industry Inquiries and Literature Search for
Scrubber Efficiency Data

EPA contacted a number of operators of commercial or industrial hazardous waste incinerators to obtain scrubber efficiency data on removal of HCl from incinerator exhaust gases. In addition, EPA reviewed technical literature search was made for this type of data for full-scale (as opposed to pilot-scale) incinerators. These data, plus data obtained from plant trips, or other sources are presented in Table 2.

Results of recent surveys are summarized in Appendix B.

TABLE 2

HAZARDOUS WASTE INCINERATOR SCRUBBER EFFICIENCY FOR HCl ABSORPTION

Operator Identity and Facility Location	Incinerator Capacity, 10 ⁶ Btu/hr.	Waste Composition	Scrubber System	Scrubber liquid	Efficiency of HCl
M Company Cottage Grove, MI	90	72% H ₂ O 28% Solids (mostly PVC)	Quench Chamber Venturi Scrubber Sieve Plate Tower	Water	99.1% 99.3%
Rollins Environmental Services, Deer Park, Texas	100-110 (or 22 to 24,000 gpd of wastes)	Highly variable waste compositions	Quench Chamber Venturi Scrubber Single-tray Absorber	Dilute lime Slurry	99.65% (Sept. 1980 test)
Cincinnati Liquid/Fluid Industrial Waste Disposal Facility, Cincinnati, OH	142	Variable Waste Compositions	Quench Chamber Venturi Scrubber Sieve Plate Scrubber (3 plates)	Dilute Sodium Hydroxide (NaOH)	100% (no HCl de- tected in stack gas dur- ing trial burn)
Eastman Kodak Co. Rochester, NY	90 (Equivalent to 9x10 ⁶ gal. of liquid waste and 6x10 ⁶ solid waste, per year)	34 different solid wastes and also varied liquid wastes, HCl load- ing is 100- 200 lb./hr.	Quench Chamber Venturi Scrubber	Water (pH control using NaOH)	92-97%
Shell Chemical Co.	NA	Liquids (65% Cl, by wt.), plus some vapors	3-stage Scrubber	Water	>99%
	NA Two similar Operating units	Chlorinated Hydro- carbon vapors	2-stage	Water in first stage Dilute NaOH in second stage	>99%
Shell Chemical Co. Norco, LA	NA	Combined liquid and vapor wastes, all chlorinated hydrocarbons	3-stage Scrubbers	Mississippi River water in first & third stages, dilute NaOH in second stage	>99%
	NA This unit has a complete, normally not operated back-up	Chlorinated hydro- carbon vapors	3-stage Scrubbers	Mississippi River Water	>99%

99% removal is infeasible, HCl more easily removed than other halogens

Based on the above discussion the Agency disagrees that a 99% removal efficiency for HCl is infeasible. Three of the incinerator tests performed in the OSW 1975-1976 series, where scrubber removal was determined, all yielded removal efficiencies of 99% or better (5). Additional inquiries and literature articles indicate to the Agency that 99% removal efficiency can and is being achieved (46,47,48).

The Agency agrees that its data is primarily on HCl removal in scrubbers and that other halogens including elemental chlorine may not be removed to such a high efficiency. The regulation has been modified to clearly indicate that the 99 percent removal efficiency applies only to hydrogen chloride.

Stack emissions should be determined case-by-case based on human health impact. The Agency agrees that a single removal efficiency for all situations will allow different actual mass emission rates of HCl. While it still may be desirable to apply the best control technology available, a more precise way of controlling halogen emission would be to evaluate each case based on human health impacts. EPA is today proposing a variance procedure to allow evaluation and restriction where needed of all incinerator emissions including hydrogen halide and halogen emissions. The reader is referred to the background document on the proposed variance for a complete discussion.

The 0.5% halogen limit should apply to total waste. The Agency agrees with this point and this was the original intent.

The final regulation has been clarified to state that the 0.5% limit applies only to chlorine as a portion of total waste feed.

Variance based on OSHA. The Agency is considering whether Threshold Limit Values (TLV's) on which the OSHA standards are based can be used if appropriately modified. The use of TLV's to evaluate and specify emission limits is fully discussed in the background document for today's proposed procedure to vary the performance standards (§264.343).

Base Level Emission Rate

The Agency agrees in part with the comment suggesting a minimum emission level of hydrogen halides below which air pollution control equipment is not needed. Such a standard would be desirable. The problems with setting such a limit are:

- 1) The impact of a specific emission rate is different for each incinerator. Factors such as stack height, wind speed and direction, population distances and densities, etc., affect the impact on human health and the environment.
- 2) Current data on exposure to hydrogen halides by the general population are lacking, currently only work place exposure standards have been set.
- 3) In the final regulation; the Agency has instead chosen to trigger the requirements for air pollution control (APC) devices by an analysis of the chlorine content of the waste (0.5%). The APC device then must meet a 99% removal efficiency which EPA has shown to be readily achievable.

The 0.5% chlorine content limit is derived from the chlorine content of coal. The combustion of fossil fuels, particularly coal, results in significant discharges of HCl to the atmosphere. Discharges of HCl from coal combustion (e.g., power plants) will be many times the quantity of HCl expected from the incineration of hazardous wastes. As already mentioned, ambient exposure limitations for HCl have not been established except for the workplace (OSHA). There is no compelling rationale to base a limit on chlorine content which is less than coal which will be used in massive relative quantities. Studies have been done which conclude that the chlorine content of American coal ranges from 0.01 to 0.5% and further that 93 to 98% of the chlorine was emitted as HCl in a series of controlled studies (79).

4. Rationale for the Final Regulation

The Agency has decided to retain the 99% removal efficiency for HCl when the waste feed contains more than 0.5% chlorine. EPA has determined that 99% removal is state-of-the-art (45, 46, 47, 48). The final standard does now clearly indicate that the performance is determined on HCl gas and not on other hydrogen halides for which the Agency has little or no data.

The final regulation differentiates among forms of halogen emissions. Organic halogens are addressed through the destruction and removal efficiency equation or may be designated as POHCs. Other forms of halogens, such as metallic salts may be not considered a problem because they are non-toxic and/or are usually found in the incinerator ash.

The proposed regulations included toxic metals in the destruc-

tion efficiency requirement. Commenters objected on the basis that non-organic components cannot be thermally destructed and that 99.99 percent removal in the fly ash and bottom is not feasible.

Destruction and removal efficiency could be applicable to metals because it considers removal of waste constituents in the emission control system. Thus, metals which exit as particulates could be controlled in this way and thus included in the destruction and removal efficiency calculation. However, the Agency elected not to apply the DRE standard to metals in the regulation because the Agency has no test data to indicate what specific removal levels are achievable. The Agency is requesting comment on the feasibility of establishing specific removal limits for metals in the regulation.

The Agency also considered whether metals were adequately addressed through standards developed under the Clean Air Act. The only existing standard applicable to hazardous waste incinerators addresses beryllium which is controlled through a National Emission Standard for Hazardous Air Pollutants (NESHAPS). A NESHAPS standard for mercury applies to sludge incinerators but not hazardous waste incinerators. A National Ambient Air Quality Standard has been established for lead.

For metals other than beryllium, the Clean Air Act regulations are inadequate for hazardous waste incinerators. EPA is today proposing that emission limits be set on a case-by-case basis by assessing the risk to human health. For metals for which EPA has developed dose response models, health effect

assessments using those models would be made.

5. Final Regulatory Language

§264.343(b) - An incinerator burning hazardous waste containing more than 0.5% chlorine must remove 99% of the hydrogen chloride from the exhaust gas.

F. Particulate Emissions

1. Summary of the Proposed Regulation

The Proposed Rules in §250.451 included the following standard on emissions of particulate matter:

The incinerator shall be operated in a manner that assures that emissions of particulate matter do not exceed 270 milligrams per dry standard cubic meter (0.12 grains per dry standard cubic foot) at zero excess air. Compliance with this requirement may be achieved by having particulate emissions which, when corrected to 12 percent CO₂ by the formula below, are less than 180 milligrams per standard cubic meter (0.08 grains per dry standard cubic foot).

$$PE_C = PE_m \times \frac{C_s}{C_m \times 1.5}$$

Where:

PE_C = corrected particulate emissions, mg/m³

PE_m = measured particulate emissions, mg/m³

C_s = stoichiometric CO₂ concentration, ppm

C_m = measured CO₂ concentration, ppm

2. Summary of Comments on the Proposed Regulation

- Use of the equation given in the Proposed Rules to normalize the particulate emissions to a 12% CO₂ concentration in the exhaust gas is desirable.
- Use of the particulate correction equation is undesirable, since it will result in allowable emissions greatly in excess of existing standards.

- There is a need for a comprehensive definition of the term "particulates" with respect to hazardous waste incinerators.
- Question if new source performance standard of 0.08 is appropriate for existing incinerators which would have to be retrofitted to meet the standard.
- 0.08 is too stringent for small incinerators. It becomes very expensive to remove the small amounts.
- Clean Air Act, State Implementation Plan standards should be used to set particulate limits and scrubber efficiencies.
- Incineration of explosive waste should be exempt from the 0.08 standard. Instead limit particulates to 50 grains per pound of explosive waste and auxiliary fuel.
- Particulates for 1000°C to 1200°C combustion are primarily inorganic salts or carbon that are not hazardous and should not be controlled any more stringently than any other sources of particulates.
- Use of the proposed 0.12 grains/DSCF is much greater than the N.Y. State Standard for Cement Kilns (0.05 grains/DSCF).

3. Response to Comments

Concentration equation. The Agency agrees with the commenter who questioned the validity of the equation in the proposed regulation. The equation for correcting measured particulate emissions for CO₂ concentration has been dropped in the standard. The current regulation refers the user to Clean Air Act Regulations Subpart E, 40 CFR §60.50 - §60.54, "Standards of Performance for Incinerators."

Definition of Particulate. The Agency is incorporating a "particulate standard which the Clean Air Act has applied to municipal and sludge incinerators. The Agency has no basis

for altering the definition from that used in those regulations.

Applicability to existing or small incinerators; relationships to State SIPS. Existing incinerators including small incinerators should be required to comply with a particulate requirement to a minimum level. This is important because recent data indicate that unburned hazardous waste components may be emitted as particulates (72). While the proposed case-by-case determination of emission limits for metals addresses this problem, a baseline level of control is needed particularly in the absence of the variance procedure. Particulate emissions are controlled under the National Ambient Air Quality Standards and thus are addressed in State Implementation Plans (SIPS). However, incinerators below a certain size may not be addressed in State Implementations. Any hazardous waste incinerator should at least meet the basic particulate standard that applies to other (municipal) incinerators. With current technology this standard is easily achieved, and many States already impose far more stringent point source emission limits.(80)

Incineration of explosives. Comments regarding particulate limits when incinerating explosives are not relevant. Waste explosives may be destroyed by open burning if the provisions of §265.382 are followed. If so, the particulate limit will not be applicable. The Agency is aware of specially designed incinerators which can handle certain explosives. Should such incinerators come into commercial use, the Agency will consider the need for a variance from the particulate standards.

Nature of particulates. The comment that particulates resulting from 1000 to 1200°C combustion are primarily inorganic salts or carbon is wrong. Examples exist where hazardous materials have been emitted either as particles or absorbed on particles (35,36).

The New York Standard. The Agency agrees with the comment on the more stringent State particulate standard for cement kilns, and has indicated in the rules for State programs authorization that State Standards may be more stringent than Federal Standards but not less stringent. Thus if a state decides to regulate cement kilns burning hazardous wastes it is free under RCRA to enforce a more stringent standard.

Also, at the present time EPA has excluded cement kilns from regulation under the Subpart O standards due to resource (heat value) recovery considerations. Thus, the final particulate standard for incinerators burning hazardous waste are not being applied to cement kilns.

4. Rationale for the final regulation

The Agency decided that the proposed standard for particulates should be maintained in the regulation. Particulates from hazardous waste incineration may be hazardous (72,54). This standard is the only national emission standard established specifically for incineration under the Clean Air Act. Under the Clean Air Act it applies only to municipal and sewage sludge incinerators. The Agency has decided that this standard represents the minimum level for control of particulates from hazardous waste incineration.

EPA's test work on full-scale incinerators supports the use

of the existing CAA particulate standard for incinerators (1). Table 3 summarizes the results of that test program. Eleven of the fifteen tests achieved particulate levels significantly lower than the standard of 180 mg/m^3 . These results range from a low of 3 mg/m^3 up to a maximum of 113 mg/m^3 . Of the three test results which exceeded the standard, the 196 mg/m^3 from the cement kiln test is high because of the dusting from the cement process. This was not unexpected since combustion of the wastes containing chlorine produces HCl and Cl_2 which react with the alkali in the cement to form volatile alkali chlorides. The particulate loading on the precipitator is therefore increased. Also, condensed alkali chlorides tend to be fine and possess a different resistivity which often means that they pass through the precipitator more easily (87). Although this higher particulate level occurred during these tests, the New Source Performance Standards for cement kilns under the Clean Air Act are in the order of 0.03 gr/DSCF and therefore far more restrictive than the 0.08 limit in these regulations. (80)

The other two results (1430 and 630 mg/m^3) were from the fluidized bed incinerator tests and these also are high due to the inherent particulate problem with this type of technology. The particulates, mostly sand, comprising the fluidized bed are quite readily carried out of the incinerator by the high velocity of the combustion gases. Maintaining the solid bed contents is one of the major operational problems with this technology. This technology would not be approved for use on hazardous waste

TABLE XX
Summary of EPA Testing of Commercial Scale Incinerators

Facility & Type	Waste Tested	Temperature °C	Residence Time	Destruction Efficiency o/o	Combustion Efficiency o/o	Particulates in stack mg/m	Scrubber Efficiency o/o HCl removed
Marquardt (5) Liquid Injection	Ethylene	1349-1752	0.14-0.19 sec.	> 99.99	99.98	20-25	N/A
	C-5, 6	1348-1378	0.17-0.18 sec.	> 99.999	99.98	36-113	>99
	API separator bottoms	760	12.5 min.	N/A	N/A	23-88	N/A
Chem-trol (5) cement kiln	Styrene	650-760	12.5 min.	N/A	N/A	28-43	N/A
	Rubber	760	15 min.	N/A	N/A	9-14	N/A
	Chlorinated blend	1450	5-10 sec.	> 99.989	-	196	-
	Above with PCB's	1450	5-10 sec.	> 99.986	-	178	-

TABLE XX (Con'd)
Summary of EPA Testing of Commercial Scale Incinerators

Systems (1) Technology	Phenol	740-757	12-14 sec.	> 99.999	> 99.96	1200-1430	N/A
Fluidized Bed	Methyl Methacry- late	774-788	12 sec.	> 99.999	> 99.97	560-630	N/A
Zimpro (5) Wet Air Oxidation	Coke plant	279 107 A+H	1.15 hr.	90	N/A	3	N/A
	Aniben •	281 107 A+H	1.0 hr.	90	N/A	11	N/A
3M (9) Rotary kiln	Polyvinyl Chloride	870 in kiln 980-1090 in secondary zone	2-3 sec.	> 99.996	> 99.97	71	99.1 - 99.3
Rollins (5)	PCB Ca- pacitors, hammer- milled	1252 in kiln 1331 in after- burn	3.2 sec.	> 99.999	> 99.98	35	-
Rotary Kiln	PCB Ca- pacitors, whole	1339 in kiln 1332 in after- burn	3.08 sec.		> 99.98	53	-
Rollins (5) Liquid Injec- tion	Nitro-	1307-1332	2.3	> 99.999	99.99	14.16	99.8

Sources: Facility Reports numbers one through six, Destroying Chemical
Wastes in Commercial-Scale Incinerators, EPA Contract

Burning Waste Chlorinated Hydrocarbons in a Cement Kiln,
Report EPS 4-WP-77-2 Fisheries and Environment Canada, (1977).

unless all performance standards could be met (\$264.343).

The 99.99% DRE may actually provide a higher level of particulate control in those cases where a designated POHC is emitted as particulate matter, since the 99.99% DRE is on a total mass basis, which includes particulates.

5. Final regulatory language (\$264.341)

(c) An incinerator burning hazardous waste must not emit particulate matter exceeding 180 milligrams per dry standard cubic meter (0.08 grains per dry standard cubic foot) when corrected for 12% CO₂, using the procedures presented in the Clean Air Act regulations, "Standards of Performance for Incinerators", 40 CFR 60.50, Subpart E.

G. Operating Standards/Performance Monitoring

1. Summary of the Proposed Regulation. The proposed regulation included several operating and monitoring requirements:

- §250.45-1(d)(1) required that the incinerator operator at minimum conditions of 1000°C, 2 seconds retention time, and 2 percent excess oxygen, except that wastes containing halogenated aromatics were required to operate at minimums of 1220°C, 2 seconds retention, and 3 percent excess oxygen.
- §250.45-1(d)(2) stipulated a combustion efficiency of 99.99% as a continuous operating and monitoring requirement.
- §250.45-1(c) required monitoring in both trial and operational burns of the following parameters:
 - Combustion temperature
 - Carbon monoxide and oxygen in the exhaust gas
 - Rate of hazardous waste feed, fuel, an excess air to the combustion system at minimum intervals of 15 minutes.

2. Comments on the proposed regulation Temperature, retention time, excess oxygen

- Comments cited the EPA study on pesticide destruction where temperatures of 500°C to 900°C were used to completely destroy hazardous wastes (pesticides). This indicates that 100°C is unnecessary to destroy some hazardous waste.
- The criteria do not account for the effects of turbulence and mixing in the incinerator.
- The majority of existing incinerators cannot meet these requirements.
- The requirements of 1200°C, 2 second and 3% excess oxygen will cause:
 - a) excess nitrogen oxides to be formed
 - b) equipment life to be shortened,
- Use of flame temperature as the temperature criterion would be more uniform in the ability to accurately monitor all incinerators.
- Time-temperature criteria may be more appropriate for infectious waste.
- The regulations are not worded to require that gases be held at temperature for two seconds.
- Suggest that the time, temperature and oxygen requirements be made a "note", i. e., only one of several ways to demonstrate compliance.

Combustion Efficiency

- The minimum CE should be reduced from 99.99% because of the lack of sensitivity in monitoring CO. Suggested values for a new CE ranged from 98.6% to 99.8%.
- Compliance with a 99.9% CE was unreasonable or impossible, especially with solid wastes.
- The formula to calculate CE is not the same as the one in the PCB incineration regulations.
- CE should be deleted from the regulations for various reasons, as follows:
 - CE is not indicative of incinerator performance,

- Specification of CE is beyond the scope of the regulations,
- It is not practical to specify both CE and DE because it is too restrictive, and
- CE does not take into account the total carbon in the fuel and waste feed.

Monitoring Requirements

- Continuous monitoring of combustion temperature is helpful in insuring proper operation of incineration, and the temperature measurement should be taken in the same place and manner in operating runs as in trial burns.
- It is not clear where the combustion temperature is to be measured. It could be the incinerator wall, the combustion zone, or the flame itself. Recommend that the "flame temperature" be used as the controlling criteria.
- Equipment to monitor CO and O₂ continuously is expensive and is beyond the state-of-the-art for a high temperature corrosive exhaust gas.
- It is difficult to obtain accurate CO measurement in certain ranges. Monitoring "combustibles", including CO will provide more accurate results.
- Why is it necessary to measure CO₂, CO and excess oxygen? Why not simply measure CO and oxygen only. If a significant presence of CO is detected, action can be taken to control incomplete combustion. The presence of O₂ in the gas leaving the final after-burner, combined with CO measurement, will provide ample monitoring of combustion performance.
- Continuous monitoring of CO and O₂ in exhaust gases is difficult and expensive, and not of sufficient value to make the expense and manpower needed worthwhile.
- Monitoring at intervals not exceeding 15 minutes should be required for trial burns and day-to-day operations for combustion temperature, CO and O₂ content of water gases, and feed rates for hazardous wastes, fuel and excess air feed.

- Monitoring requirements for each operational burn should be enlarged to include a measure of the destruction efficiency of the burn and the constituents of the exhaust gas.
- Orsat stack gas analysis should be made in accordance with EPA method 3 - gas analysis for carbon dioxide, oxygen, excess air and dry molecular weight.
- Delete continuous monitoring of CO if a trial burn shows sufficient excess air will assure efficient combustion.

3. Response to Comments

Temperature, Retention Time, Excess Air

As discussed under Part V of this document the Agency agrees with the many commenters who felt that the proposed incinerator operating conditions did not provide sufficient flexibility to deal with the wide range of wastes and incinerator designs. Consequently, the Agency will no longer apply these proposed requirements on a uniform, nationwide, basis. The regulations now state that these operating conditions will be defined in the permit on a case-by-case basis as the conditions demonstrated as capable of meeting a performance requirement of 99.99% DRE.

Combustion Efficiency

The Agency agrees that the calculation of combustion efficiency is cumbersome for the following reasons:

1. CO₂ is difficult to accurately measure on a continuous basis; it must be sampled before the combustion gases pass through any wet scrubbing process.
2. CO₂ is present at some level in the input air;
3. The CO/CO₂ dynamics are constantly changing in the combustion zone.

Consequently, EPA is no longer requiring the maintenance of a minimum combustion efficiency or the calculation of a combustion efficiency. Instead, a simple limit of carbon monoxide emissions will be specified in the permit issued in accordance with Part 122. This limit will be defined from trial burn data or from information submitted in lieu of a trial burn. The measurement of CO, however, is practical on a continuous basis and can be used as a final monitoring check on the completeness of combustion.

Monitoring

The Agency believes that continuous monitoring of combustion conditions is necessary in order to monitor compliance with the 99.99% DRE. This is essentially a substitute for the monitoring of DRE on a continuous basis. However, such DRE monitoring is impractical because of the complexity (and cost) of the sampling and analysis required. Consequently, combustion conditions associated with that performance will be determined during the trial burn, specified in the permit, and monitored to determine compliance. Monitoring of such conditions is both technically and economically feasible (23, 25, 36, 50, 51, 52, 53).

Temperature Monitoring

From an operational viewpoint, incinerator temperature is the most important and easily determined indicator of the stability of hazardous waste combustion and destruction. EPA definitely agrees with the comment that combustion zone temperature measurements should be taken in the same place and manner in operational runs as in trial burns.

The precise location of temperature indicating devices in the combustion chamber of an incinerator is a matter that the EPA feels should be specified on a case-by-case basis by the permitting official. All three possible locations mentioned by the commenter could be satisfactory as long as they were kept constant for both trial and operational burns and showed a reasonable relationship to incinerator performance. Some operators install temperature indicating devices at more than one location in an incinerator combustion chamber. Contrary to the comment regarding the difficulty and reliability of temperature indication in a hot, corrosive environment such as one containing halogens or hydrogen halides, a thermocouple based on, for example, platinum/platinum-10% rhodium is accurate and reliable (5).

CO, CO₂, O₂ Monitoring

The Agency disagrees with the commenters who suggested that CO monitoring is difficult, expensive, or technically infeasible. The Agency feels that CO monitoring is feasible, practical, and necessary for the following reasons:

- CO concentration in the exhaust gases is a good indicator of the completeness of combustion. Carbon Monoxide was monitored during the EPA test burns with no significant difficulty and results were used to compute combustion efficiency (5,64,66,69,71).
- Well developed, reliable and rugged instrumentation exists that can measure the concentration of CO in exhaust gases in a range from a very few parts-per-million to a 100% basis (49).
- Response time of the equipment is rapid (1-90) seconds, (depending on instrument) (54,55).
- Measurement of CO maintains its meaningfulness as an

indicator of the completeness of combustion as the excess air is lowered toward stoichiometric, or as combustion temperatures are lowered.

- Instrumentation does not need to be mounted in the gas stream, and a non-sampling, non-contacting methodology for measuring the CO content of a flowing gas stream can be utilized (49,54,55).
- The cost of the instrumentation (roughly \$1500 - \$3000) is normal, considering the capital required to build a complete hazardous waste incinerator (56).

The comment that "combustibles" in the exhaust gas should be monitored because this measurement would produce more accurate results than monitoring CO alone, is infeasible for several reasons. First, as noted above, CO monitoring instruments of acceptable accuracy are readily available. Second, EPA has not been able to identify a reliable, off-the-shelf instrument for measuring total combustibles in the gas to the accuracy and concentrations required (although instruments are available for measuring gaseous combustibles) (14). Third, and most important, EPA considers that data on the CO and particulate content of exhaust gas, together with data on the combustion temperature, and air flow rate provide an adequate indication of the degree of completeness of combustion of most organic wastes. A general requirement for monitoring exhaust gas combustibles other than CO is therefore unnecessary.

With respect to comments recommending one set of parameters monitored during a trial burn, and another set during operational burns, the same parameters should be monitored during trial and operational burns, in order to insure comparability. There are no compelling reasons to use different parameters.

A comment suggested that any monitoring of CO₂ should be at a point upstream of any scrubber due to the solubility of CO₂ in water. The Agency is not requiring CO₂ monitoring in the regulation.

In order to ensure that the incinerator is achieving a 99.99% DRE, monitoring of combustion zone temperature and of CO is necessary whether or not sulfur, nitrogen or halogens are elemental components of the waste being incinerated. Similarly, monitoring of waste feed rate, fuel, and total air feed to an incinerator in both trial and operational burns is necessary since these parameters are a requisite to establishing stable operating conditions, and to assuring that the destruction and removal efficiency is achieved.

The comment that NO_x, SO_x, and CO₂ be added to the list of monitored gases will not be followed. The Agency is attempting to minimize monitoring requirements and only specify those that have an impact on the destruction of hazardous compounds in the incinerator. NO_x can be an important pollutant if many combustion sources are found in any area, but it is of secondary interest in the combustion of many highly toxic or carcinogenic hazardous wastes. The risk from potential emissions of these compounds, unburned or partially burned, far exceeds the small addition to ambient NO_x from an incinerator. Further, NO_x as well SO_x is a criteria pollutant subject to the National Ambient Air Quality Standards under the Clean Air Act, and should be adequately controlled through those standards.

CO₂, as discussed in the section on CO monitoring, will be absorbed to a significant degree through scrubbing, and thus monitoring in the stack would be of little value. If Orsat stack gas analysis were used for CO monitoring then EPA Method 3, Gas Analysis for Carbon Dioxide, Oxygen, Excess Air and Dry Molecular Weight, should be used (52). However, EPA doubts that such a labor-intensive analyzer would be useful where frequent analyses are needed, and good accuracy is required for low CO values. The intent in continuous CO monitoring is to provide a rapid response readout to detect incinerator upset conditions quickly and start either immediate remedial control actions or a shutdown.

EPA does not agree that CO monitoring should be deleted if it can be shown during a trial burn that excess air will assure 99.99% DRE. Such a change would not be in keeping with EPA's rationale for requiring continuous carbon monoxide monitoring. EPA has determined that CO monitoring of the exhaust gases is the simplest, most reliable method of detecting changes in incinerator combustion conditions (i.e., temperature, excess air rates, waste feed rates) which directly and immediately affect the quality of the emissions of the incinerator. Also it should be pointed out that CO monitoring will immediately detect problems with deficiencies of air in the combustion process.

4. Rationale for the Final Regulation

The regulation, in §264.343, establishes performance requirements for incinerators based on achieving a destruction and

removal efficiency (DRE) of 99.99% for both the principal organic hazardous constituents (PHOC's) in the waste and hazardous combustion by-products. The Agency has adopted performance standards in preference to specification of national standards for operating conditions such as temperature, retention time, and excess air. The rationale for this decision is provided in paragraph 3 above and in Part V of this document.

However, the destruction and removal efficiency cannot be monitored on a continuous or frequent interval basis, because the complexity, lag time for analysis, and cost of continuous sampling and analysis required to determine the precise amounts of POHCs and combustion by-products in the feed to, and exhaust gas from, the incinerator. Because of this, it is necessary to determine in the trial burn the critical operating conditions associated with meeting of this standard, to specify limits on those conditions in the permit, and then to monitor and and enforce those operating conditions.

EPA does reserve the right to verify the DRE directly by direct sampling and analysis of the feed stream, residues and the exhaust gas at any time during normal operation. This enforcement monitoring is expected to occur infrequently, probably on a yearly basis. However, if the Agency has sufficient reason to suspect that an incinerator is not achieving the performance standards as specified in the permit, than more frequent sampling and analysis may be required.

Continuous monitoring of combustion conditions is necessary and is both technically and economically feasible. From an

operational viewpoint, incinerator temperature is an important and easily determined indicator of the process integrity. The instruments (or other devices) which measure the combustion conditions (temperature, excess air, etc.) should be monitored and operational corrections made often continuously and automatically where possible. The relevant parameters on which the combustion conditions depend, in most incinerators include waste feed rate, auxiliary fuel, can lead to poor combustion conditions and to emission of incompletely burned wastes. Some facilities already have some of these control loops (temperature controlling auxiliary fuel flow, for example) operating on a continuous basis. In fact, the available literature indicates that it is not unusual to find continuous monitoring (5,12,19,23,25,36,49). A number of highly accurate, continuously indicating instruments are available for CO, CO₂, and O₂ in exhaust gases (50,51,52). The techniques for using these instruments are relatively simple, they are off-the-shelf items, and they are not unduly expensive.

The Operating Requirements (§264.345) which have been specified in the regulation as critical to determining incinerator performance are largely the same as those proposed. The rationale for selecting each is presented below:

CO level on the stack exhaust gas

EPA will no longer require the maintenance of a uniform minimum combustion efficiency. Instead, a limit of carbon monoxide emissions will be specified in the permit on a case-by-case basis. This limit will be determined from trial burn data

or from information submitted in lieu of a trial burn.

The measurement of CO has been selected as a appropriate combustion-control parameter for the following reasons:

- CO concentration in the exhaust gases is a good indicator of the completeness of combustion.
- Well developed, reliable and rugged instrumentation exists that can measure the concentration of CO in exhaust gases in range from a very few parts-per-million to a 100% basis (49).
- Response time of the equipment is rapid, 1-90 seconds, (depending on the instrument) (54,55).
- Measurement of CO maintains its meaningfulness as an indicator of completeness of combustion as the excess air is lowered toward stoichiometric, or as combustion temperatures are lowered.
- Instrumentation does not need to be mounted inside the gas stream, and a non-sampling, non-contracting methodology for measuring the CO content of a flowing gas stream can be utilized (49,54,55).
- The cost of the instrumentation (\$1500 - \$3000) is nominal, considering the capital required to build a complete hazardous waste incinerator (56).

Some continuous indicator of the combustion performance of the incinerator is essential. Combustion performance (like CO level) depends on operating parameters such as temperature, feed rate of waste, and air flow rate, but monitoring those operating parameters does not indicate what is actually being accomplished in the incinerator. Monitoring CO levels in emissions does give a continuous (and almost instantaneous) assessment of effectiveness of combustion.

The Agency considered whether CO could be used as a sole indicator for compliance with the DRE requirements, but rejected this option. Determination of a precise quantitative relation-

ship between CO level and DRE under various burn conditions is not feasible. A literature review presented here illustrates the wide range of CO values for different processes.

<u>CO Level, ppm, in Exhaust Gas</u>	<u>Source</u>
30-40	Most coal-burning utility boilers (73)
> 1	Commercial hazardous waste incinerator (74)
5-50	Trial burns of miscellaneous hazardous waste several test facilities (5,75)
0-5200	Pilot plant test data (76)

Thus, the final regulations specify both monitoring of key operating conditions and monitoring of CO as an indicator of incinerator performance. The acceptable range of CO will be determined from the trial burn. A range will be specified in the permit conditions based on the CO levels during the trial burn. In this way, the range will be relevant to the performance standards.

Although monitoring of CO is more convenient in an exhaust stack (where temperatures are low), measure of CO at other points within the system (for example, in the take-off ducting immediately after the combustion chamber, or afterburner) are also acceptable.

Waste Feed Rate

As stated above, waste feed rate is one of the critical control parameters on which combustion conditions depend. Incinerators are designed for a certain capacity, or total heat input. A feed rate of waste and fuel which exceeds the heat

capacity of the incinerator will generally result in incomplete combustion. The capacity limits, are directly related to the feed rate of the waste, the heating value of the waste, the amount and heating value of auxiliary fuel, and the amount of air fed. Thus, the achievement of a 99.99% DRE will be dependent on the feed rate and it's relation to the other parameters mentioned above.

Combustion Temperature

Destruction efficiency is closely linked to combustion temperature as discussed above. This temperature is such a critical and commonly accepted condition affecting incinerator performance that the proposed regulations specified a minimum temperature for burning all wastes. It will now be set on a case-by-case basis.

Air Feed to the Combustion System

In order for combustion to be complete there must be sufficient oxygen present to complete the oxidation of the waste. The exact quantity required is referred to as "stoichiometric" quantity. Excess air (above the stoichiometric quantity,) is used to ensure adequate oxidation. This parameter was also specified in the proposed regulations.

For an incinerator volume and configuration the specification of air feed rate and waste feed rate together define the retention time of waste in the combustion system, a parameter defined in the proposed regulations but no longer uniformly required. Instead, EPA is requiring case-by-case specification of air feed rate in the permit, based on the results of the trial burn.

Variation in Waste Composition

The conditions (ranges) of temperature, waste feed rate, and air feed rate required to achieve 99.99% DRE will be established on a waste-by-waste basis, or on the basis of different waste mixtures. However, the feasibility of this approach depends on being able to define ranges of waste composition that remain subject to these same requirements, since waste feed compositions cannot be expected to remain absolutely constant. Composition may change either because the concentration of principal hazardous components in a given waste change or because different "new" components are introduced through blending or mixing of wastes. Given conditions of temperature, waste feed, and air feed should insure 99.99% DRE for a range of waste compositions. Establishing this range will require the engineering judgement of the permitting official. The guidance provided in the "Permit Writer's Guidelines for Hazardous Waste Incinerators" will aid in this judgement.

Importantly, the permit applicant also has significant control over these ultimate ranges. If the applicant conducts trial burns for wastes or waste mixtures which are very difficult to destruct, for example halogenated aromatic compounds, the acceptable range of waste composition which can be burned at those conditions may be relatively broad. The trade-off from the standpoint of the owner or operator is that he can incinerate a broader range of waste composition at the conditions established in the permit, if he is willing to operate at relatively stringent conditions. In practice, owners or operators who burn a wide

range of wastes or waste mixtures are likely to want to conduct trial burns and establish operating conditions for two or more different groups of wastes, ranging from those which are difficult to burn to those which combust relatively easily.

Incinerator Design and Operating Changes

The permit will be written based on results of trial burn(s), or data submitted in lieu of a trial burn and will be applicable to the configuration of incinerator hardware used to gather the data. Changes to the hardware of the system could result in different results even when burning similar hazardous wastes. Since the DRE is not monitored continuously during normal day-to-day operation, and since modifications to the incinerator could result in failure to meet the DRE, permit conditions will include provisions related to possible significant system design and operation factors.

Examples of changes which could affect the DRE include:

1. A change in the design of a liquid injector nozzle to reduce clogging could also change the mixing characteristics of the wastes and combustion air and potentially reduce DRE.
2. A change in the incline or speed of rotation of a rotary kiln can greatly affect the time for which solid materials are retained in the kiln and thus their exposure to the temperatures required to destroy them.
3. Movement of temperature sensing probes to a different location in the incinerator which could affect the

apparent temperature reading. This change could allow an incinerator to run at a lower real temperature when instrument readouts were within the permit conditions.

Changes resulting from normal maintenance will not normally be included e.g., replacement of refractory linings.

5. Final Regulatory Language

§264.345 Operating Requirements

(a) An incinerator must be operated in accordance with operating requirements specified in the permit. These will be specified on a case-by-case basis as those demonstrated (in a trial burn or in alternative data as specified in §264.344(b) and included with Part B of a facility's permit application) to be sufficient to comply with the performance standards of §264.343.

(b) Each set of operating requirements will specify the composition of the waste feed (including acceptable variations in the physical or chemical properties of the waste feed which will not affect compliance with the performance requirement of §264.343) to which the operating requirements apply. For each such waste feed, the permit will specify acceptable operating limits including the following conditions:

- (1) Carbon monoxide (CO) level in the stack exhaust gas;
- (2) Waste feed rate;
- (3) Combustion temperature;
- (4) Air feed rate to the combustion system;
- (5) Allowable variations in incinerator system design or operating procedures; and

- (6) Such other operating requirements as are necessary to ensure that the performance standards of §264.343 are met.

(c) During start-up and shut-down of an incinerator, hazardous waste (except ignitable waste exempted in accordance with §264.340) must not be fed into the incinerator unless the incinerator is operating within the conditions of operation (temperature, air feed rate, etc.) specified in the permit.

(d) Fugitive emissions from the combustion zone must be controlled by:

- (1) Keeping the combustion zone totally sealed against fugitive emissions; or
- (2) Maintaining a combustion zone pressure lower than atmospheric pressure; or
- (3) An alternate means of control demonstrated (with Part B of the permit application) to provide fugitive emissions control equivalent to maintenance of combustion zone pressure lower than atmospheric pressure.

(e) An incinerator must be operated with a functioning system to automatically cut off waste feed to the incinerator when operating conditions deviate from limits established under paragraph (a) of this Section.

(f) An incinerator must cease operation when changes in waste feed, incinerator design, or operating conditions exceed limits designated in its permit.

§264.346 [Reserved]

§264.347 Monitoring and Inspections

(a) The owner or operator must conduct, as a minimum, the following monitoring while incinerating hazardous waste:

- (1) Combustion temperature, waste feed rate, and air feed rate must be monitored on a continuous basis.
- (2) CO must be monitored on a continuous basis at a point in the incinerator downstream of the combustion zone and prior to release to the atmosphere.
- (3) Upon request by the Regional Administrator, sampling and analysis of the waste and exhaust emissions must be conducted to verify that the operating requirements established in the permit achieve the performance standards of §264.343.

(b) The incinerator and associated equipment (pumps, valves, conveyors, pipes, etc.) must be completely inspected at least daily for leaks, spills, and fugitive emissions. All emergency waste feed cut-off controls and system alarms must be checked daily to verify proper operation.

(c) This monitoring and inspection data must be recorded and the records must be placed in the operating log required by §264.73.

§§264.348 - 264.350 [Reserved]

H. Operating Practices - Preheating of Incinerators

(See discussion in interim status standards.)

I. Operating practices - fugitive emissions

1. Summary of proposed regulations

The proposed regulations required in §250.45-1(d)(4) that fugitive emissions of unburned hazardous waste and combustion products be controlled.

2. Comments on the proposed regulations

- The primary combustion chamber should be monitored to insure negative pressure and thus prevent leakage.
- The regulations should be stated as an achievable practical technology.
- Emissions are already regulated under the Clean Air Act. The regulation violates the congressional mandate to avoid duplication.
- Fugitive emissions cannot be eliminated. Sources of fugitive emissions are:
 - a. Tank vents,
 - b. Maintenance disassembly.
 - c. Pump seals that often require that a definite leak rate be maintained.
 - d. Purging of equipment for repairs,
 - e. Burner observation ports.
 - f. Rotary kilns must have openings to permit thermal expansion and to allow cool air to protect the metal retaining rings.

3. Response to Comment

The definition of fugitive emissions (see definition Section) illustrates the difficulty of measuring these from typical installations. They originate from other than stacks or vents. They exit through holes, faulty seals, etc. The regulatory solutions proposed are therefore intuitively founded. It

is clear that a sealed combustion zone will control fugitive emissions. Similarly, in those cases where sealing is not possible, e.g. rotary kiln, maintaining a pressure in the combustion zone which is lower than that outside (i.e., negative pressure) will reduce emissions to the maximum practical extent. Even though sudden surges in air flow can still cause fugitive emissions (25), the Agency knows of no other solutions which can insure that fugitive emissions are eliminated.

A specific regulation, e.g., maintain 3 inches of water negative pressure, is not possible because of the difficulty of measuring small pressure differentials at high temperatures (77). Additionally, maintaining a negative pressure may not be applicable to certain types of facilities. For example, it may be more appropriate to require a sealed burning zone in the case of fluidized bed incinerators, which operate under positive pressure.

EPA agrees that all fugitive emissions cannot be completely eliminated from incinerators and associated operations. However they can be minimized.

Maintenance, purging, etc., can be accomplished using auxiliary fuel with hazardous waste input to the system shutoff.

4. Rationale for the final regulation

Control of fugitive emissions from hazardous waste incineration is important because those emissions - which typically are emitted from the combustion chamber - can contain quantities of the hazardous waste being burned or hazardous combustion by-products (1).

The Agency realizes that fugitive emissions of hazardous materials from the operation of an incinerator cannot be totally eliminated. Tank vents, leaks, pump seals, maintenance work, and other associated operations are the source of many fugitive emissions. However, the Agency in this regulation is concerned with the hazards from the escape of incompletely burned gases from the combustion zone of the incinerator, and feels that some control is necessary.

One solution to the problem of fugitive emissions is to require that the incinerator operate at a negative pressure (i.e., less than atmospheric). This would minimize leakage from the unit. In fact, many incinerators do operate in this manner, but sudden pressure surges can still cause fugitive emissions (25).

A second solution for systems which are not or cannot be operated with a negative pressure, is to seal all leaks in the combustion zone. This may not be practical in all cases.

In the final regulations the Agency has stated that incinerators may operate under a negative pressure, operate with a sealed system or may use a system to control fugitive emission which in the Administrator's best judgement will eliminate fugitive emissions or reduce them to levels equivalent to negative pressure controls.

5. Final regulatory language

§264.345

(d) Fugitive emissions from the combustion zone must be controlled by:

- (1) Keeping the combustion zone totally sealed against fugitive emissions; or
- (2) Maintaining a combustion zone pressure lower than atmospheric pressure; or
- (3) Alternate means of control demonstrated (with Part B of the permit application) to provide fugitive emissions control equivalent to maintenance of combustion zone pressure lower than atmospheric pressure.

J. Operating Practices - Automatic Cutoff

1. Summary of proposed regulations

The proposed regulations required in 250.45-1(d)(3) that an incinerator be equipped with a device to automatically cutoff waste feed when significant changes occur in critical operating parameters.

2. Comments on the proposed regulations

Comments received on 250.45-1(d)(3) are summarized as follows:

- EPA should require cutoff only of the toxic waste stream but allow auxiliary fuel to keep firing the incinerator if desired. This recognizes that the fuel stream may be fuel oil or low-toxicity material.
- The automatic cutoff should be based on significant changes in combustion efficiency, destruction efficiency or other combustion conditions.
- The "significant changes" are not defined relative to waste feed cutoff.
- The wording of the proposed cutoff standard defeats and eliminates the possibility of using wastes-as-fuel.

- It may be inadvisable to cutoff waste feed instantaneously. Instead, alarms should be used and not waste feed cutoff. Leave the details of how to correct combustion conditions to the operator.
- EPA should exempt "low-toxicity" wastes from the cutoff procedure.

3. Response to Comments

EPA agrees with the comment that the cutoff provision should apply only to the hazardous waste stream and not necessarily to a non-hazardous auxiliary fuel stream. This approach was intended to be followed in the proposed regulation 250.45-1(d)(3). By allowing continued or increased feeding of auxiliary fuel during the cutoff of the hazardous waste feed, the incinerator will not be subjected to rapid changes in temperature. Thus, two purposes are served: (1) maintenance problems associated with thermal expansion/contraction cycles of refractory linings will be averted, and (2) operating problems which triggered cutoff of the hazardous waste stream can possibly be corrected without necessity for an expensive and time-consuming shut-down and subsequent start-up.

The Agency agrees in part with the comment that the waste cutoff should be based on changes in combustion efficiency, destruction efficiency or other combustion conditions. Adverse changes in combustion parameters such as temperature and carbon monoxide (CO) content of exhaust gases should trigger a waste cutoff, but so should other non-combustion problems such as break-downs in scrubber operation or in other air pollution control devices. However, it should be realized that changes in DRE cannot be shown until suitable analytical data are avail-

able, which may be hours or days after an upset. Therefore, the use of DRE for this purpose is not practical. Further, for reasons discussed elsewhere in this document the Agency has decided not to utilize the concept of combustion efficiency, but will base its judgement of stable combustion conditions on the continuous monitoring of CO in the exhaust gas.

In the final regulation, the selection of the operating parameters and the extent of any "significant changes" in them which will trigger the shut-down of the waste feed will be made by the permit writer. Also, the results of any trial burns are expected to supply data to help in specifying the degree of operating changes which will require an automatic shut-down. Guidance is included in the "Permit Writer's Guidance Manual" on ranges of waste properties, operating parameters and other factors to aid the permit writer.

The Agency does not agree with the comment that the proposed regulation would eliminate the use of wastes as fuel. First, the burning of hazardous waste primarily for recovery of energy is currently exempted from the RCRA standards. Second, if a high BTU waste were being burned in a permitted incinerator to offset the low heating value of another waste, it would be subject to the cutoff requirement. However, a conflict between energy recovery and environmental protection is not a necessary or inevitable part of the RCRA regulations.

EPA agrees with the comment that an instantaneous cutoff of waste feed in some cases, may not be the best operating procedure. In many incinerator operations the cutoff provisions

may in reality be a phased approach with adequate warning to the incinerator operator before the activation of an automatic cutoff valve. It would seem prudent to provide an alarm on the controlling instruments to warn the operator that an operating parameter has gone out of the allowable range. This alarm would allow a reasonable amount of time for the operator to attempt to correct the condition and/or provide time to bring up the feeding of auxiliary fuel before the automatic system cuts off all waste feed. The specification of these alarms and the procedures and times allowed to respond before shut-down, will be determined on a case-by-case basis relying on the judgement of the permit writer.

The Agency agrees in part with the suggestion that some wastes which are of "low toxicity" may be exempted from the cutoff procedure. Wastes which are hazardous due only to their ignitability are exempted from the final incinerator regulation.

In developing the final regulation the Agency has developed language which allows the permit writer to specify procedures which must be taken in the event an incinerator parameter(s) exceeds the range of value(s) specified in the permit. Automatic cutoff of hazardous waste feed is the primary shut-down procedure but other types of procedures may also be effective in protecting human health and the environment. These may either replace or modify automatic feed shut-off or affect some other operating parameter in an emergency situation. The engineering judgement of the permitting official will determine what these procedures must be.

4. Rationale for the final regulation

EPA believes that the waste cutoff systems to the incinerator should be activated based on changes in critical combustion conditions. Changes in combustion parameters such as temperature and carbon monoxide (CO) content of exhaust gases should trigger a waste cutoff, but so should other combustion problems such as break-downs in scrubber operations or in other air pollution control devices. However, changes in DRE cannot be proven until suitable analytical data are available, which may be hours or days after an upset. Therefore, monitoring of DRE cannot be used directly to trigger shut-down.

The results of any trial burns are expected to supply data to help in specifying the degree of operating changes which will require an automatic shut-down, e.g., temperature range for complete combustion. In many incinerator operations the cutoff provisions may in reality be a phased approach with adequate warning to the incinerator operator before the activation of an automatic cutoff valve. It would seem prudent to provide an alarm on the controlling instruments to warn the operator that an operating parameter has dropped out of the allowable range. This alarm would provide a reasonable amount of time for the operator to attempt to correct the condition and/or provided time to activate the feeding of auxiliary fuel before the automatic system cutoff of all waste feed. This phased approach can be used as long as no toxic or hazardous components are discharged out of the stack i.e., DRE is not violated. By allowing continued or increased feeding of auxiliary fuel during

the cutoff of the hazardous waste feed, the incinerator will not be subjected to rapid changes in temperature. Thus, two purposes are served:

- (a) maintenance problems associated with thermal expansion/contraction cycles of refractory linings will be averted, and
- (b) operating problems which triggered cutoff of the hazardous waste stream can possibly be corrected without the necessity of an expensive and time-consuming shut-down and subsequent start-up.

In developing the final regulation the Agency has developed guidance which allows the permit writer to specify procedures which must be taken in the event an incinerator parameter(s) goes outside the range of value(s) specified in the permit of hazardous waste feed.

Automatic cutoff is the primary shut-down procedure but other types of procedures may also be effective in protecting human health and the environment which either replace or modify automatic feed shut-off or effect some other operating parameter in an emergency situation. Table 4 presents a summary of responses to system malfunctions.

TABLE 4

HAZARDOUS WASTE INCINERATOR MALFUNCTIONS, AND
REMEDIAL OR EMERGENCY RESPONSES

No.	Malfunction	Type Incinerator*	Malfunction Indication	Response
1	Partial or complete stoppage of liquid waste feed delivery to all liquid burners:	L C	(a) Flow meter readings out of specified range. (b) Pressure build-up in feed lines (c) Change in combustion zone temperature (d) Feed pump failure, zero amps.	Halt waste feed, start trouble-shooting and maintenance in affected systems. Reinitiate or increase auxiliary fuel feed to maintain com- bustion zone temperatures; continue operation of air pollution control devices (APCD)
2	Partial or complete stoppage of liquid waste to only one burner.	L C	As in (a), (b) and (c), above	Halt waste feed to affected burner, only.
3	Partial or complete stoppage of solid wastes feed to rotary kilm.	RK C	(a) Drop in RK combustion temperature (b) Power loss in waste feed conveyor or other feed system.	As in 1, above

*L = Liquid injection; RK = rotary kiln; C = Combination liquid injection and rotary kiln.

TABLE 4 (Continued)

No.	Malfunction	Type Incinerator*	Malfunction Indication	Response
4	"Puffing", or sudden occurrence of fugitive emissions from RK due to thermal instability or excessive feed rate of wastes to RK, or failure of seals.	RK C	(a) Pressure surge in kiln (rapid change in manometer level) (b) Visible emission from air seals at either end of kiln	(a) Halt feeding of any solid waste to kiln for 10-30 min, but continue combustion. (b) Evacuate unneeded personnel from immediate vicinity of kiln (c) Reevaluate waste prior to further incineration.
5	Failure of forced air supply to liq. waste feed or fuel burners	L RK C	(a) Flowmeter reading for air supply off scale (b) Automatic flame detector alarm activated. (c) Zero amps. or excessive current draw on blower motor(s)	(a) Halt waste and fuel feed immediately. (b) Start trouble shooting immediately and restart as soon as possible. (c) Continue operation of ARD's but reduce air flow at induced draft fan by "damping" accessory.

TABLE 4 (Continued)

No.	Malfunction	Type Indicator*	Malfunction Indication	Response
6	Combustion temperature too high	L RK C	(a) Temperature indicator(s) at instrument control panel (b) Annunciator, or other alarm sounded.	(a) Check fuel or waste feed flow rates; reduce if necessary. (b) Check temperature sensors. (c) Check other indica- tors in combustor, if multiple sensors used. (d) Automatic or manual activation of combus- tion chamber vent (sometimes called an "emergency stack cap")
7	Combustion temperature too low	L RK C	(a) - as above (b) - as above	(a) Check other indica- tors in combustor, if multiple sensors are used. (b) Check fuel or waste feed flow rates; increase if necessary (c) Check sensor accuracy. (d) Cease waste feed flow.

TABLE 4 (Continued)

No.	Malfunction	Type Incinerator*	Malfunction Indication	Response
8	Sudden Loss of Integrity of Refractory Lining	L RK C	(a) Sudden loud noise (b) Partial stoppage of air drawn into combustor, resulting in decreasing combustion temperatures, increased particulate emissions, and development of hot spots on external of combustor shell.	Shut down facility as quickly as possible, immediately cease waste feed flow, secure feed lines against leakage.
9	Excess opacity of stack plume	L RK C	Visual, or instrument opacity readings which are above maximum allowable operating point.	(a) Check combustion conditions, especially temperatures O_2 (excess air) and CO monitor. (b) Check APCD operation (c) Check nature and feed rates of wastes being burned (d) Check ESP ramping interval, cycle duration and intensity.
10	CO in exhaust gas in excess of normal CO values.	L	CO indicator	Check and adjust combustion conditions, especially temperature and excess air (O_2 in stack gas), and adjust accordingly.

TABLE 4 (Continued)

No.	Malfunction	Type Incinerator*	Malfunction Indication	Response
11	Indication of or actual failure of Induced Draft Fan	L RK C	(a) Motor overheating (b) Excessive or zero current (amps) (c) Total stoppage of fan (d) Pressure drop across blower inlet and outlet	(a) Switch to standby fan, if available (b) If two induced draft fans are used in series, reduce operational levels immediately, stop the failing unit, and operate at reduced rate on one fan only, until maintenance can be completed. (c) If there is only one fan, and the fan failure appears serious, shift into an emergency shutdown mode for entire incinerator.
12	Increase in gas temperature after quench zone, affecting scrubber operation	L RK C	(a) Partial or total loss of water supply to quench zone (b) Increase of combustion temperatures	(a) Check water flow to quench zone. Prepare for limited operation rate until water supply is restored (b) Check combustion conditions, especially temperature.

TABLE 4 (Continued)

No.	Malfunction	Type Indicator*	Malfunction Indication	Response
13	Partial or complete stoppage of water or caustic solution to scrubber(s).	L RK	(a) Decrease in pressure cross scrubber, as in- dicated by manometers, or other instruments	(a) Halt waste feed, start trouble- shooting and main- tenance in affected system. (b) Start up refundant pumps, if available (c) Check recycle water or solution tank levels. (d) If using alkaline solution, switch to water supply if available (e) Check for deposition of solids from recycled liquors in pump lines (f) Use emergency (stand-by) water supply which will feed water by gravity until the whole system can be shut- down
			(b) Zero or increased amps on water or solution pumps	
			(c) Flowmeter readings out of specified range.	
			(d) Large increase in acid components in stack gas as detected by NDIR or other type instruments.	

TABLE 4 (Continued)

No.	Malfunction	Type Incinerator*	Malfunction Indication	Response
14	Deposition of solids in scrubber from recycled wastes or caustic solution, or from excess solids emissions from combustor.	L RK C	(a) Build-up of pressure across scrubber as indicated by manometers or other instruments. (b) Increased hold-up of liquor in packed or tray towers, up to and including flooded condition. This can also be detected by liquid level indicators.	This requires a shutdown to clean out the tower and internals. The shut-down scheduled if the deposit build-up is gradual and is monitored.
15	pH of recycled scrubber liquor not in spec	L RK C	(a) Continuous, or spot-checking pH indicator shows actual pH to be outside of desired operating range. (b) Drop in scrubber efficiency with excess acid gas in stack gas.	(a) Check for adequate supply and metering of alkaline agent. (b) Check accuracy of pH meter and alkaline solution metering pump associated with recycling of scrubber liquor.
16	Failure of demister operation	L RK C	Increased pressure as measured by manometer, due to solids accumulation in demister element.	Rack-wash element.

5. Final regulatory language

\$264.345

(e) An incinerator must be operated with a functioning system to automatically cut off waste feed to the incinerator when operating conditions deviate from limits established under paragraph (a) of this Section.

K. Trial Burns

1. Synopsis of the Proposed Regulation

In Section 250.45-1(b) of the proposed standards, EPA specified that owners and operators would conduct a test to demonstrate compliance with performance standards before a significantly different hazardous waste could be routinely incinerated. The standard spelled out certain measurements, testing, and calculations which could provide data to evaluate the performance of the incinerator.

2. Summary of the Comments

- Proposal is unclear as to the meaning of "principal toxic component", whether weight, volume or degree of hazard is specified. "Principal" should refer to the highest degree of hazard established by EPA.
- The use of the term "significantly different" is too vague.
- EPA should not require trial burns if data already exists.
- Trial burns would be "unworkable" for boilers and general purpose incinerators since boiler operations cannot be interrupted and general purpose incinerators would always need trial burns since they burn so many different wastes -- an annual waste characterization is suggested.
- Suggest air, ground, and water emission permits instead of trial burns for destruction efficiency, combustion efficiency, and sulfur emissions.

- Test for CO, CO₂, and O₂ in the hot zone exit gases prior to the emission control device. Particulates should be measured in stack after the emission control device.
- DE should be monitored in routine burns as well as in trial burns.
- There is no specification of how many trial burns will be required.
- Suggest using a lab-scale, flowing device to determine ignition temperature, etc., to classify wastes into degrees of severity and similarity.
- There is a problem for those operators who blend wastes - they would have to do a lot of trial burns.
- Trial burns can cost \$50,000 - \$70,000 for lab analysis, and over \$100,000 in total. This is a big burden which is unnecessary. Suggest EPA rely on judgement of experts.
- Suggest determining "generic categories" to reduce amount of trial burns, or "ranking" criteria.
- Trial burn results should be submitted to the Regional Administrator. (Suggested times for submittal ranged from 7 days to 6 months.)

3. Response to Comments

Principal Toxic Component. This comment was discussed under paragraph D. It is now referred to as principal organic hazardous component and will be specified by the permit writer on a case-by-case basis.

Significantly different waste. The Agency agrees that the term "significantly different waste stream" (in terms of when a trial burn may be required) is vague and has clarified this. The regulation requires that variability of waste feed be held within limits set in the permit, and further states that trial burns are required for a waste not covered in the

permit for the facility. This will define, "significantly different". The variability limits will be based on the best engineering judgement of the permitting official. To assist in this judgement the Agency has developed a guidance manual and an engineering manual, one function of which is to provide guidance on this issue.

Use of existing data. EPA agrees with the comments that if trial burn data and information already exist that are relevant and sufficient to the problem at hand, then new trial burns are not needed. The regulation in this area allows the applicant to submit information on whether or not trial burns are viewed as necessary. In a proposal to waive trial burns, the applicant must furnish detailed information to show that acceptable Destruction and Removal Efficiency will be attained in the proposed incinerator.

Boilers and multiple waste incinerators. The Agency exempted boilers from the hazardous waste incineration regulations in the May 19, 1980 regulations. However the Agency is investigating the types and volumes of wastes which are disposed of in boilers, and expects to soon propose regulations for burning of certain wastes in boilers. The Agency agrees that multiple waste, i.e., offsite, incinerators, will require a number of test burns. However, without such burns, there would be no assurance of protecting human health. The Agency believes that there are procedures which can minimize trial burns. See below "Trial Burns on Waste Blends".

Destruction efficiency; combustion efficiency, and scrubber efficiency. Comments relative to scrubber efficiency and combustion efficiency are discussed in paragraphs F and H respectively. As discussed elsewhere in this document, air emission limits for the large variety of hazardous emissions from an incinerator can only be set on a case-by-case basis based on a trial burn.

Hot zone sampling. The hot zone of an incinerator is normally neither a safe nor an effective environment in which to make accurate measurements of quantities such as the CO, CO₂, and O₂ levels present (see paragraph G discussion on monitoring). Such determination can be hazardous to the workers and may yield results which are difficult to interpret or use. Sampling may also release fugitive emissions. Therefore, the Agency has considered these arguments in the total scenario for abandoning the destruction efficiency parameter in favor of the new destruction and removal efficiency requirements. Thus hot zone sampling is no longer required.

Monitoring of destruction efficiency. Comments that destruction efficiency should be a requirement not only of the trial burns but of the routine disposal operations were considered carefully, but the Agency has determined that this is impractical. Measurement of DRE requires stack sampling and testing. While such testing is possible it is expensive to conduct even on an intermittent basis. Further, in order to be effective for process control, DRE would have to be monitored continuously and interpreted immediately. This is not possible with current technology.

Instead, the Agency believes the continuous monitoring of surrogates (e.g., temperature, CO level, etc.) will be more effective and practical. This matter is discussed further in paragraph G.

Number of trial burns. The exact number of trial burns required was questioned. It is difficult to make a generalized statement applicable to all situations because of the large number of incinerator/waste combinations possible. The Agency will examine each case on an individual basis. It will, however, be the Agency policy to keep both the duration and the number of trial burns to a minimum, in order both to reduce the threat to human health and the environment in the event that the trial burns are characterized by unacceptable destruction performance, and to minimize the cost to incinerator owners or operators.

Lab-scale device to classify wastes. The comment on use of a laboratory-scale device to determine ignition temperature and other parameters relative to full scale operations is a good one. The Agency feels that the data can be useful in guiding subsequent testing at pilot and full scale levels and in limited cases could be used to guide full scale burning decisions. Results from lab-scale burns may be submitted as part of the documentation called for by 264.344(b).

Trial burns on waste blends. The incinerator operating permit will specify the upper and lower limits of physical properties and certain chemical properties such as concentra-

tion, types of constituents, etc. of wastes which can be fed to the incinerator. For many offsite incinerators the properties of blended wastes are of primary concern rather than individual wastes as they are received. It is likely that a facility operator will blend wastes for storage and the number of different blends will be far less than the number of individual wastes received. The trial burns can themselves be conducted on blended wastes since what is essential is the waste feed to the incinerator. The operator may even use blending as a operational tool to achieve blend quality which is within specified permit limits. The more storage tanks which are available at a facility, the wider the range of flexibility for blending. Thus, the need for new trial burns can actually be reduced through the use of careful blending.

Trial burn costs. The Agency disagrees with comments that trial burn costs are typically in the range of \$50,000 - \$100,000. Such cost estimates are overstated by including certain costs of normal operation, personnel, fuels, administrative overhead, etc. Such costs are generally not incremental and therefore not allocatable to trial burn costs. Engineering estimates for trial burn costs have been made by EPA and its contractors and found to be in the order of 4- 5000 dollars per day including analytical costs.(58,59) It would be very unusual for a facility to be in a trial burn mode for more than a few days.

Trial burns are essential to determine the incinerator operating conditions required to meet a 99.99% DRE. The commenter's suggestion that EPA make judgements in the absence

of data, is unacceptable. However, the regulations do provide an option for data to be supplied without conducting a trial burn. The regulations allow other burn data or combustion data from other incinerators burning the same or similar wastes to be submitted in lieu of trial burn data, provided the data is judged applicable and sufficient. In determining the acceptability of this alternative data, the judgement of the permitting official, augmented by agency expertise, will be used. The data base will grow as burn experience is gained, which will reduce the need for new trial burns over time.

Incinerability Criteria. The Agency agrees with the comment that "generic categories" or a "ranking" system should be developed and does plan to develop incinerability criteria for use in guiding permit writers. This guidance will be made a part of guidance documents prepared to accompany the regulation. There are many possibilities for approaching such a ranking system. Approaches include molecular structure, heat of combustion, molecular weight, excess or activation energy, auto - ignition temperature and many others. Even though these approaches are based on characteristics of chemical compounds rather than wastes or waste mixes, a useable approach would help reduce the potential number of trial burns. There are several components to the use of incinerability data to reduce trial burn requirements and serve as the basis for permits:

- 1) Previous work by EPA's office of Research and Development. This will be continued in the future.
- 2) Development of a data base for cataloging trial burn

data and information (actual data will confirm or deny previously developed theories related to a chemical basis for burnability).

- 3) Data gathered from many sources which will have been submitted in lieu of a trial burn plan by owners or operators desiring a permit.

The reader is referred to a later portion for additional discussion on these points in the rationale for the regulation.

Submission of Trial Burn Results. EPA agrees with the commenter who suggested that a requirement for submittal of the trial burn results to the Regional Administrator be stated. This requirement is important for two reasons:

- 1) If excessive emissions occurred during the trial burn, then the permitting authority must be aware of the incident, and,
- 2) The development of the data base for permitting actions requires that trial burns that do not meet the performance standards be reported and made a part of the data base. Knowledge of the failures are as important, if not more important, than information obtained on trial burns which demonstrated full compliance with Subpart O performance standards.

The Agency has added a requirement to the final trial burn standards that all trial burn results must be submitted to the Regional Administrator.

4. Rationale for the final regulation

Trial burns are an essential part of the regulation of

incinerators. If a "new" waste were burned in an operational incinerator without a trial burn, and the combustion conditions were not sufficient to adequately destroy that waste, then hazardous emissions could result which could damage human health and the environment. A trial burn may be the only feasible way of determining operating conditions necessary to meet a performance standard - such as 99.99% destruction and removal efficiency. Destruction efficiency cannot be measured continuously as a performance standard. Thus, the trial burn serves the purpose of defining those operating conditions - temperature, retention time, excess air - required to meet that performance standard. Those operating conditions then become the parameters monitored and enforced regularly.

Further, the Agency has stipulated that a trial burn not be conducted without prior approval of a trial burn plan. There are two primary reasons for this. One is to provide reasonable assurance that the trial burn itself won't damage human health and the environment. The second is to make sure that the data developed during the trial burn will be satisfactory to support a decision on issuance of a permit, and to define the conditions of that permit. This includes agreement on the number, length, and duration of burns required. Therefore, the final regulation requires a trial burn plan, and stipulates that the plan include certain information, such as the test protocol, the composition of the wastes to be burned, and the sampling procedures which will be used.

It follows that the trial burn plan will itself become a condition of the burn permit and will include those determinations which the Regional Administrator approves in the trial burn plan. The final regulation lists certain minimum determinations of each trial burn. These determinations are those necessary to assess compliance with the 99.99% DRE, and the operating conditions associated with achievement of that standard. It also includes analysis for hazardous combustion by-products, so that the permitting official can determine whether these emissions verify the DRE calculations made by other means.

One of the key concerns of the Agency regarding trial burns is that they not become an onerous burden that would discourage or delay the progress of hazardous waste disposal by incineration. There are two concerns in this regard. The first is that significant delays could result if a permit modification (or new permit) were required prior to each trial burn. Because of this concern the regulation provides that trial burns can be conducted in accord with special short term permitting requirements under Part 122.27 (b).

The second concern about the burden of trial burns is that they could potentially become frequent events at facilities handling many different wastes, effectively tying up significant capacity and adding to costs. The regulation attempts in to avoid this problem. Two provisions address this. First, trial burns are required only for wastes not covered in the permit. As discussed in section H, acceptable variation in

waste composition is a required condition of a permit. Thus, the regulations recognize that the permit conditions apply not only to the specific wastes for which trial burns have been conducted, but also to variations of this waste or waste mixture, if those variations will also meet the applicable performance standards. Secondly, the final regulation provides that a trial burn need not be conducted if data can be supplied from other trial or operational burns on similar waste in similar incinerators. These points are elaborated below.

The determination of acceptable variation in waste composition to be included in a permit is a judgement which the permitting official must make. If, for example, an incinerator is currently burning waste A and the operator desires to burn waste B, how different must the two be before it is deemed that either a modified permit is required or a new set of trial burns required?

The approach that the Agency finds is the most reasonable is that of a "hierarchy of waste incinerability". Candidate wastes will be grouped in categories, so that within each category, the wastes will be approved for burning in the facility provided the permit conditions remain the same. An incinerator may be approved for the destruction of any other category which is determined to be more readily "incinerable". See additional discussion in this section (section K) on "Incinerability Criteria".

The permitting official will rely on engineering judgement

to determine whether a trial burn is necessary, and on data such as that developed by Lee (57). Lee examined the thermal degradation characteristics of fifteen compounds and developed a correlation of degradation temperature and residence time versus the following:

1. Number of carbon atoms
2. Aromatic compound or not
3. Existence of saturation
4. Presence of nitrogen in the molecule
5. Presence of oxygen in the molecule
6. Hydrogen/carbon ratio
7. Existence of a carbon double bond; chloride interaction in the molecule
8. The auto-ignition temperature of material.

In addition to this work, the Agency has identified other criteria for waste similarity which may be of benefit to the permitting official:

- physical state, (e.g., solid, liquid, sludge)
- elemental composition, (e.g., presence of metals)
- hazardous components (e.g., dioxins)
- viscosity (relate to burning type and configuration)
- moisture content (percent water)
- heating value (BTU content, potential for blending with other wastes)
- percent solids (e.g., burner design)
- ash content (residue handling)
- flash point (temperature limits)

Specific limits and ranges of values for each of the above

parameters which are judged to be representative of similar wastes are specified by the Agency in the Permit Writer's Guidelines (46). This information should be useful both in establishing waste variability limits in the permit, and in judging the suitability of data supplied in lieu of a trial burn.

Likewise, similarity between two or more incinerators must be determined wherever data from a previous incinerator is offered by the applicant for a permit in lieu of a trial burn, or in order to support the decision to use specific test conditions on a proposed trial burn. In this case, the Agency has identified seven items or characteristics of incinerators which must be similar or must meet specified limits:

- type of incinerator (e.g., rotary kiln, fluidized bed)
- combustion zone temperature (wide variations will cause different destruction efficiencies)
- excess air or ratio of air feed rate to waste feed rate (e.g., too low excess air can result in incomplete combustion, too high excess air can result in low temperature and incomplete combustion)
- components and dimensions (e.g., burner design and combustion zone site and configuration)
- residence time (related to destruction and removal efficiency)
- air pollution control devices (affects removal efficiency)
- auxiliary fuel use

The Agency is requesting various kinds of data and information in, a) trial burn plans, b) reports of trial burns, and c) part B applications for permits. All of this information is related in one way or another to the DRE. In some cases, the

relationship is direct, e.g., measurement of the POHC in the stack gas during a trial burn. In other cases the relationship is not as apparent or may be suspected, and direct relationships may only be well defined after the experience of many trial burns and full scale operational burns. An example of an indirect relationship is information on incinerator hardware. Another example is products of incomplete combustion measured during the trial burn.

The Agency has recent information which indicates that potentially hazardous products of incomplete combustion or combustion by-products, may be found during incineration of hazardous wastes and in other instances (13,6,11,17,72,78,79,80,81,82,84).

Chlorine - containing compounds can be dechlorinated and free radicals formed in the combustion zone. Chlorine is formed during this process. The presence of chlorine makes possible re-chlorination of certain other compounds. An example of this is formation of hexachlorobenzene from benzene. Biphenyl (unchlorinated PCB) residuals could become chlorinated, thus becoming in turn more difficult to burn and perhaps more toxic. Hundreds of reactions are possible in wastes containing only a few hazardous constituents. To most effectively protect the health and environment, as much as possible must be known about:

- a) the waste matrix - thus the requirement for waste analysis,
- b) fuel - fuel may be the waste or constituents of the

waste, fuel for secondary combustion reactions might consist of PICs from primary reactions

- c) oxidizer - oxygen supplied in air stream or chemically bound
- d) by-products of combustion - related to efficiency of combustion, CO, CO₂, other organics.

The Agency is not regulating the discharge of products of incomplete combustion (PICs) at this time because of a lack of data related to attainable or expected destruction efficiency under various burn conditions. Regulations are being proposed now however, to deal with this problem (also see reference 83). It is clear however, that based on preliminary research the formation of PICs is intimately related to the destruction of and destruction efficiency of the compound from which they were formed (78). The chemistry of these interactions will become better understood only as more data are available. Even now however, the measurement of PICs will help in understanding and verifying calculations of DRE. Additional details are also provided on this matter in the permit writers guidance (58, 79).

Referring back to the seven items, residence time should be no less than 5% below and no more than 100% above that of the previous incinerator. The Agency is also developing data in several other areas to aid exercise of engineering judgement in lieu of repetitive trial burns. Specifically:

- (1) The Agency has started a recordkeeping system to document all test burn data which is currently available and which will be generated as new permits are

issued. These data will be available to permit writers, owners, and operators of incinerators, the public, and equipment manufacturers to establish a system to rapidly disseminate trial burn results to all interested parties. Techniques to use existing data for new incinerator/waste type combinations will be developed as part of EPA's effort to better understand incineration of hazardous wastes. The Agency has added a requirement that all data obtained during a trial burn conducted under an approved trial burn plan shall be submitted to the Agency. This requirement is needed to insure that the data base for development of best engineering judgement for each incinerator is complete. It will also help to build a data base. A trial burn which is unsuccessful in meeting performance standards provides as much if not more information about incinerator operation as a successful trial burn. Also, it is necessary because incinerator owners and operators may be reluctant to reveal performance results which do not meet the performance standards unless they are required too.

- (2) EPA's Office of Research and Development has developed and is currently using a laboratory method of studying the thermal decomposition of waste constituents. This method, called the "Thermal Decomposition Analysis System", (TDAS) allows the controlled study of the

conditions under which compounds are decomposed by high temperature processes. The analysis of decomposition products is done by either gas chromatography or gas chromatography-mass spectroscopy.

The types of information generated by the TDAS fall into two broad categories.

- What are the minimum residence time/temperature conditions needed to destroy a waste or a hazardous material?
 - If the above minimum conditions are not attained, what are the combustion by-products or products of incomplete combustion (PIC) which could form during the incineration process?
- (3) ORD is also building a pilot scale incinerator facility at Pine Bluff, Arkansas, which will contain one or more small incinerators. These units will be used to study the incineration process to develop the basic engineering understanding of the destruction of waste materials. This facility will also be available to run tests on wastes which are of concern to the Agency to develop data for full scale/applications.

Thus, anticipates that the ability to make engineering judgements in lieu of actual trial burn tests will develop rapidly over the next five year period. These efforts by the Agency will reduce the impact of trial burn requirements on owners and operators of incinerators.

5. Final regulatory language

§264.344 New Wastes: trial burns or permit modifications

(a) The owner or operator of a hazardous waste incinerator may burn only wastes specified in his permit and only under operating conditions specified for those wastes under §264.345, except:

(1) In approved trial burns under §122.27(b) of Chapter; or

(2) Under exemptions created by §264.340.

(b) Other hazardous wastes may be burned only after operating conditions have been specified in a new permit or a permit modification as applicable. Operating requirements for new wastes may be based on either trial burn results or alternative data included with Part B of a permit application under §122.25(b)(5) of this Chapter.

§122.27 - Short Term Permits

(b) Trial burn permits. For the purposes of determining feasibility of compliance with the incinerator performance standard of §264.343 of this Chapter and of determining adequate incinerator operating conditions under §264.345 of this Chapter, the Director may issue a trial burn permit to a facility to allow short term operation of a hazardous waste incinerator subject to paragraphs (b)(1) - (5) of this Section.

(1) The trial burn must be conducted in accordance with a trial burn plan prepared by the applicant and approved by the Director. The trial burn plan will then become a condition of the permit. The trial burn plan will include the following information:

(i) An analysis of each waste or mixture of wastes to be burned which includes:

(A) Heat value of the waste in the form and composition in which it will be burned.

(B) Viscosity (if applicable), or description of physical form of the waste.

(C) An identification of any hazardous organic constituents listed in Part 261, Appendix VIII of this Chapter, which are present in the waste to be burned, except that the applicant need not analyze for constituents listed in Part 261, Appendix VIII, of this Chapter which would reasonably not be expected to be found in the waste. The constituents excluded from analysis must be identified and the basis for their exclusion stated. The waste analysis must rely on analytical techniques specified in EPA document SW-846 (referenced in 40 CFR Part 261, Appendix III), or their equivalent.

(D) An approximate quantification of the hazardous constituents identified in the waste, within the precision produced by the analytical methods specified in EPA document SW-846.

- (E) A quantification of those hazardous constituents in the waste which may be designated as POHC's based on data submitted from other trial or operational burns which demonstrate compliance with the performance standard in §264.343 of this Chapter.
- (ii) A detailed engineering description of the incinerator for which the trial burn permit is sought including:
- Manufacturer's name and model number of incinerator (if available).
 - Type of incinerator.
 - Linear dimensions of the incinerator unit including the cross sectional area of combustion chamber.
 - Description of automatic waste feed cut-off system(s).
 - Stack gas monitoring and pollution control equipment.
 - Nozzle and burner design.
 - Construction materials.
 - Location and description of temperature, pressure, and flow indicating and control devices.
- (iii) A detailed description of sampling and monitoring procedures, including sampling and monitoring locations in the system, the equipment to be used, sampling and monitoring frequency, and planned analytical procedures for sample analysis.
- (iv) A detailed test schedule for each waste for which the trial burn is planned including date(s), duration, quantity of waste to be burned, and other factors

relevant to the Director's decision under paragraph (b)(4) of this Section.

- (v) A detailed test protocol, including, for each waste identified, the ranges of temperature, waste feed rate, air feed rate, use of auxiliary fuel, and any other relevant parameters that will be varied to affect the destruction and removal efficiency of the incinerator.
 - (vi) A description of, and planned operating conditions for, any emission control equipment which will be used.
 - (vii) Procedures for rapidly stopping waste feed, shutting down the incinerator, and controlling emissions in the event of an equipment malfunction.
 - (viii) Such other information as the Director reasonably finds necessary to determine whether to approve the trial burn plan in light of the purposes of this paragraph and the criteria in paragraph (b)(4) of this Section.
- (2) The Director, in reviewing the trial burn plan, shall evaluate the sufficiency of the information provided and may require the applicant to supplement this information, if necessary, to achieve the purposes of this paragraph.
- (3) Based on the waste analysis data in the trial burn plan, the Director will specify as trial Principal Organic Hazardous Constituents (trial POHC's), those constituents for which destruction and removal efficiencies must be calculated during the trial burn. These trial POHC's will be specified by the Director based on his estimate of the difficulty of

incineration of the constituents identified in the waste analysis, the concentration or mass in the waste feed, and, for wastes listed in Part 261 of this Chapter, the hazardous waste constituent or constituents identified in Appendix VII of that Part as the basis for listing.

(4) The Director shall approve a trial burn plan if he finds that:

- (i) The trial burn is likely to determine whether the incinerator performance standard required by §264.343 of this Chapter can be met;
- (ii) The trial burn itself will not present an imminent hazard to human health or the environment;
- (iii) The trial burn will help the Director to determine operating requirements to be specified under §264.345 of this Chapter; and
- (iv) The information sought in paragraphs (b)(4)(i) and (iii) of this Section cannot reasonably be developed through other means.

(5) (i) During each approved trial burn (or as soon after the burn as is practicable), the applicant must make the following determinations:

- (A) A quantitative analysis of the trial POHC's in the waste feed to the incinerator.
- (B) A quantitative analysis of the exhaust gas for the concentration and mass emissions of the trial POHC's, CO₂, O₂, and hazardous combustion by-products.

- (C) A quantitative analysis of the scrubber water (if any), ash residues, and other residues, for the trial POHC's.
 - (D) A total mass balance of the trial POHC's in the waste.
 - (E) A computation of destruction and removal efficiency (DRE), in accordance with the DRE formula specified in §264.343(a) of this Chapter.
 - (F) If the waste feed contains more than 0.5% chlorine, a computation of chlorine removal efficiency, in accordance with §264.343(b).
 - (G) A computation of particulate emissions, in accordance with §264.343(c) of this Chapter.
 - (H) An identification of sources of fugitive emissions and their means of control.
 - (I) A measurement of average, maximum, and minimum temperatures, and air feed rates.
 - (J) A continuous measurement of CO in the exhaust gas.
 - (K) Such other information as the Director may specify as necessary to ensure that the trial burn will determine compliance with the performance standard in §264.343 of this Chapter and to establish the operating conditions required by §264.345 of this Chapter as necessary to meet that performance standard.
- (ii) The applicant shall submit to the Director a certification that the trial burn has been carried out in

accordance with the approved trial burn plan, and the results of all the determinations required in paragraph (b)(5)(1) of this Section. To the extent possible, this submission shall be made within 30 days of the completion of the trial burn, or sooner if the Director so requests.

- (iii) All data collected during any trial burn must be submitted to the Director following the completion of the trial burn. The results of the trial burn must be included with Part B of the permit application, if a permit application is submitted.
- (iv) All submissions required by this paragraph shall be certified on behalf of the applicant by the signature of a person authorized to sign a permit application or a report under §122.6.

Part 122.25

- (5) For facilities that incinerate hazardous waste, except as §264.340 of this Chapter provides otherwise, the applicant must fulfill the requirements of paragraph (b)(5)(i), (ii), or (iii) of this Section.
 - (i) When seeking exemption under §264.340(b) (Ignitable waste only):
 - (A) That the waste is either (1) listed as a hazardous waste in Part 261, Subpart D of this Chapter, only because it is ignitable (Hazard Code I) or, (2) that the waste has

been tested against the characteristics of hazardous waste under Part 261, Subpart C of this Chapter, and that it meets only the ignitability characteristic, and includes none of the hazardous constituents listed in Part 261, Appendix VIII of this Chapter; or

- (ii) Submit results of a trial burn conducted in accordance with §122.27(b) including all the determinations required by §122.27(b); or
- (iii) In lieu of a trial burn, the applicant may submit the following information:

(A) An analysis of each waste or mixture of wastes to be burned including:

- Heat value of the waste in the form and composition in which it will be burned.
- Viscosity (if applicable), or description of physical form of the waste.
- An identification of any hazardous organic constituents listed in Part 261, Appendix VIII, of this Chapter which are present in the waste to be burned, except that the applicant need not analyze for constituents listed in Part 261, Appendix VIII, of this Chapter which would reasonably not be expected to be found in the waste. The constituents excluded from analysis must be identified and the basis for their exclusion stated. The waste analysis must rely on analytical techniques specified in EPA document SW-846 (referenced 40 CFR Part 261, Appendix III) or their equivalent.
- An approximate quantification of the hazardous constituents identified in the waste, within the precision produced by the analytical methods specified in EPA document SW-846.

- A quantification of those hazardous constituents in the waste which may be designated as POHC's based on data submitted from other trial or operational burns which demonstrate compliance with the performance standard in §264.343 of this Chapter.
- (B) A detailed engineering description of the incinerator, including:
- Manufacturer's name and model number of incinerator.
 - Type of incinerator.
 - Linear dimension of incinerator unit including cross sectional area of combustion chamber.
 - Description of auxiliary fuel system (type/feed).
 - Capacity of prime mover.
 - Description of automatic waste feed cut off system(s).
 - Stack gas monitoring and pollution control monitoring system.
 - Nozzle and burner design.
 - Construction materials.
 - Location and description of temperature, pressure, and flow indicating devices and control devices.
- (C) A description and analysis of the waste to be burned compared with the waste for which data from operations or trial burns are provided to support the contention that a trial burn is not needed. The data should include those items listed in §122.25(b)(5)(iii)(A). This analysis should specify the POHC's which the

applicant has identified in the waste for which a permit is sought, and any differences from the POHC's in the waste for which burn data are provided.

- (D) The design and operating conditions of the incinerator unit to be used, compared with that for which comparative burn data are available.
- (E) A description of the results submitted from any previously conducted trial burn(s) including;
 - Sampling and analysis techniques used to calculate performance standards in §264.343 of this Chapter,
 - Methods and results of monitoring temperatures, waste feed rates, air feed rates, and carbon monoxide,
 - Identification of any hazardous combustion by-products detected,
 - The certification and results required by §122.27(b)(5)(ii).
- (F) The expected incinerator operation information to demonstrate compliance with §§264.343 and 264.345 of this chapter including:
 - Expected carbon monoxide (CO) level in the stack exhaust gas.
 - Waste feed rate.
 - Combustion zone temperature.
 - Air feed rate.
 - Expected stack gas volume, flow rate, and temperature.

- Computed residence time for waste in the combustion zone.
 - Expected hydrochloric acid removal efficiency.
 - Expected fugitive emissions and their control procedures.
 - Proposed waste feed cut-off limits based on the identified significant operating parameters.
- (G) Such supplemental information as the Director finds necessary to achieve the purposes of this paragraph.
- (H) Waste analysis data, including that submitted in paragraph (B)(5)(iii)(A), sufficient to allow the Director to specify as permit Principal Organic Hazardous Constituents (permit POHC's) those constituents for which destruction and removal efficiencies will be required.
- (iv) The Director shall approve a permit application without a trial burn if he finds that;
- (A) The wastes are sufficiently similar; and
 - (B) The incinerator units are sufficiently similar, and the data from other trial burns are adequate to specify (under §264.345 of this Chapter) operating conditions that will ensure that the performance standards in §265.343 of this Chapter will be met by the incinerator.

L. Waste Analysis

1. Summary of the Proposed Regulation

Section §250.45-1(b)(1)(i), (ii), and (iii) required as part of conducting a trial burn an analysis of: (1) the waste for halogens and principal hazardous components, (2) ash and scrubber wastes for principal hazardous components, and (3) exhaust gas for halides, CO, CO₂, O₂ and particulates.

2. Comments on the proposed regulation

Most of the general comments received on these requirements are addressed in the Background Document entitled "Waste Analysis." The few comments relating specifically to incinerators are summarized as follows:

- Required testing and analysis are unnecessary and too expensive for certain wastes.
- It is not clear what is to be tested and what owners or operators are to do with the information thus gathered.
- Site owners or operators should be able to rely on information in manifests, rather than duplicating work done by generators.
- Testing should not be required except to: (a) identify waste as hazardous, and (b) provide necessary information to the owner or operator to allow him to make decisions concerning safe management.

3. Response to comments

Testing unnecessary and expensive. It is impossible to determine destruction efficiency during a trial burn without analyzing the wastes for most of the proposed constituents. Analysis can be expensive, but the detailed analysis is required only for trial burns, and is essential

to determining incinerator performance.

Requirements unclear. To the extent that "principal hazardous component" was not defined, the Agency agrees that the waste analysis requirements relating to them were not clear. This has been addressed in the regulations by establishing criteria which the permitting official will use to define principal organic, hazardous components (POHC). However, this follows a waste analysis designed to provide information on the waste composition, which is necessary in order for the permitting official to make the judgement on hazardous components. The regulations define the type of preliminary analysis required, and is provided to further define the required analysis.

Use manifest information; limit testing. The information on the manifest contains a general identification of the waste by DOT classification code. This would not provide sufficient information to safely conduct a trial burn and determine destruction and removal efficiency. Testing must be sufficient to determine compliance with the incinerator regulation, not just a general statement of whether the waste is hazardous. (See also discussion of waste analysis in Part IV).

The Agency agrees with the comment that waste analysis requirements should be limited to identification and disposal. Both the proposed regulations

and those being promulgated now have these two purposes as the basis.

4. Rationale for the final regulation.

Waste analysis required to meet the final incineration regulations and thus to conduct incineration of hazardous wastes in a way which will protect human health and the environment consists of elements described in the previous section (Section K) on trial burns and Part 122.27(b).

Throughout operation sufficient analysis of the waste being fed to the incinerator to determine whether it is within the waste variability limits defined in the permit would be required.

Analysis of a waste for heating value, metals listed in Appendix VIII, Part 261, and halogens is relatively straight-forward. However, the identification of hazardous organic constituents in the waste is more difficult because of the analytical chemistry involved.

The Agency expects that the analysis for organic components will involve GC/MS (gas chromatography/mass spectroscopy) analytical methods. If the owner or operator has information on the probable waste content, the GC/MS analysis can be simplified. This should be the case in most instances.

In order to set bounds on the universe of toxic constituents, the Agency has specified the substances

listed in Appendix VIII of Part 261 as those to be identified (if present) in the waste. To keep the analytical task within practical bounds, the regulation provides that analysis need not be attempted for any constituent(s) which the owner or operator can show would not reasonably be expected to be found in the waste. For example, previous analyses on the same or similar wastes which have not shown certain constituents constitutes a showing.

Two types of GC/MS analytical procedure should be discussed here in order to clarify the regulatory requirement:

- a) analysis of waste where the constituents are known (e.g., listed Appendix VIII)
- b) analysis where the constituents are unknown.

The latter type of analysis using the GC/MS tool can be expensive because a complete search must be made of computer libraries of available spectra for the compounds being searched. Confirmation of compounds suspected to be present after initial searches must be made using known reference samples and analytical chemistry laboratory procedures.

Since the basis for the regulation is a listing in Appendix VII or Appendix VIII of Part 261, this open-ended searching technique is not required by this regulation. Instead the GC/MS analysis will proceed using techniques for identifying known

constituents in the waste.

It would be a rare case indeed - namely one in which the waste composition was completely unknown - where a complete scan for all of the Appendix VIII constituents would be required.

In a typical scenario no more than, say, 20 of the items listed in Appendix VIII might be chosen as potential POHC's and subsequently, less than six might be designated as POHC's for purposes of the trial burn. Based on results of the trial burn this number might be reduced even further for permitting purposes.

During the trial burn itself and during normal operational burns GC/MS technology is not required. Once the POHC's have been defined, gas chromatography, will, except in special cases, be adequate for monitoring purposes, including quantitative measurements.

The costs for the limited application of GC/MS technology during the preliminary waste analysis, and for GC technology alone during the later stages is expected to be quite reasonable - in the order of several hundreds of dollars for a given waste, to a maximum of a few thousand dollars in special cases.

5. Final regulatory language

§264.341 Waste Analysis

- (a) As a portion of a trial burn plan required by §122.27(b)

of this Chapter, or with Part B of his permit application, the owner or operator must have included an analysis of his waste feed sufficient to provide all information required by §122.27 (b)(2) or §122.25(b)(5) of this Chapter.

(b) Throughout normal operation the owner or operator must conduct sufficient waste analysis to verify that waste feed to the incinerator is within the physical and chemical composition limits specified in his permit (under §264.345(b)).

M. Instrument Monitoring and Facility Inspection

1. Summary of the Proposed Regulation

During both trial and operating burns, the following parameters (§250.45-1 (c)) were to be monitored and recorded:

- combustion temperature
- exhaust gas CO and O₂ concentrations continuously, and
- waste, fuel, and excess air feed at least every 15 minutes.

2. Comments on the proposed regulation

- New equipment to monitor gas emissions (particularly CO) would be expensive.
- 15-minute inspection of waste flows is unnecessarily rigorous.
- Points of measurement are unclear.
- NO_x, SO_x, ND CO₂ should be added to the list of monitored effluents.

3. Response to comments

Monitoring and inspection requirements were included in the interim status standards promulgated on May 19,

1980. Thus, comments on this issue are addressed in Part II of this document. Monitoring (but not inspection) is also addressed in paragraph G. However, since these regulations have been modified from those promulgated for interim status, the full rationale for the final regulations is presented here.

The Agency partially agrees with the first comment. Gas emission monitoring on a continuous basis is a relatively complex procedure involving continuous sampling techniques and on-line monitoring instrumentation. However, continuous monitoring of CO is done routinely in power plant combustion systems (41).

The Agency in the final regulation has dropped the requirement to monitor O₂, but has retained CO monitoring as an indicator of combustion conditions. EPA has determined that CO monitoring is not excessively expensive (87) and its value as a direct measurement of the completeness of combustion justifies its specification as an operation requirement (see paragraph G).

EPA disagrees with the comment that a 15-minute inspection frequency for waste flow is unnecessarily rigorous. The Agency believes that the instruments (or other devices) which measure the combustion conditions (temperature, retention time, and excess air) should be monitored as often as possible, continuously and automatically where possible. The relevant control points on which the combustion conditions depend in most incinerators include waste feed rate,

auxilliary fuel feed, and air flow. Variations in any of these, or in the heating value of either the waste or the auxiliary fuel, can lead to poor combustion conditions and to emission of incompletely burned wastes. Some facilities already have some of these control loops (temperature controlling auxiliary fuel flow, for example) operating on a continuous basis (47). The Agency encourages such continuous control, but will insist that such controls and, even more importantly, manual control loops (where the operator makes the correction), be monitored or inspected at least every 15 minutes.

No specific data base can demonstrate the wisdom of the 15-minute frequency. In some cases, where combustion conditions are subject to rapid swings, arguments can be made that more frequent monitoring and control is needed especially for highly toxic wastes. This is, however, a facility specific situation and depends on design parameters, such as the effectiveness of the instrumentation and the response period once control changes are made. Even where automatic control is installed, it is necessary to check the instrumentation to ensure that it is functioning. The 15-minute minimum ensures that improper conditions do not persist for longer than that period and ensures that the facility will not operate unattended.

Similarly, control loops which might affect emissions or which could result in spills present similar problems. These could vary, depending on the design of the equip-

ment, but often include scrubber water flows, scrubber water pH, and, perhaps, level controls on tanks. They must similarly be inspected on a 15-minute basis.

All of these inspections are to be part of the Inspection Schedule and significant results are to be recorded in accordance with the provisions of that section. Additionally, the Agency believes the entire facility should be inspected at least daily for leaks, spills, fugitive emissions, odors, and smoke. These can result in adverse human health or environmental impacts if not detected early. Control system alarms must also be inspected daily to be sure they are functioning. Again, there is no body of information which specifically supports any given frequency. Based on its own experience with incinerator test burns, the Agency has decided that inspections at these minimum frequencies is necessary.

The comment on points of measurement has been addressed in the revised regulation in §264.343. This section specifies that CO monitoring will occur in the incinerator stack after any or all air pollution control devices.

The comment suggesting that NO_x, SO_x, and CO₂ be added to the list of monitored effluents is an excessive burden for incinerators. Although SO_x and NO_x are air pollutants being regulated by EPA, the primary purpose of an incinerator is to destroy toxic compounds and prevent their release to the environment. Thus, EPA believes that to effectively meet that primary purpose and at the same time not put

excessive monitoring burdens on owners or operators of incinerators, only continuous monitoring of CO is justified.

4. Rationale for the final regulation

The need is obvious for monitoring of those parameters listed in §341.343(c) which are specified in the permit as necessary to meet a 99.99% DRE. This monitoring is the basis for determining whether the incinerator is in compliance with the regulations, as is also discussed in Section G. The 15-minute interval is considered by the Agency to be the most appropriate monitoring interval, as indicated in response to the comments above, and as described in Part IV of this document. The rationale for inspection of incinerator equipment is described fully in Part IV.

5. Final regulatory language

§264.347 Monitoring and Inspections

(a) The owner or operator must conduct, as a minimum, the following monitoring while incinerating hazardous waste:

- (1) Combustion temperature, waste feed rate, and air feed rate must be monitored on a continuous basis,
- (2) CO must be monitored on a continuous basis at a point in the incinerator downstream of the combustion zone and prior to release to the atmosphere.
- (3) Upon request, by the Regional Administrator, sampling and analysis of the waste and exhaust emissions must be conducted to verify that the operating requirements established in the permit achieve the performance standards of §264.343.

(b) The incinerator and associated equipment (pumps, valves, conveyors, pipes, etc.) must be completely inspected at least daily for leaks, spills, and fugitive emissions. All emergency waste feed cut-off controls and system alarms must be checked daily to verify proper operation.

(c) This monitoring and inspection data must be recorded and the records must be placed in the operating log required by §264.73.

N. Closure

This requirement was included in the interim status standards and is discussed fully in Part IV of this document. The final regulations include the same requirement as the interim status standards.

Final regulatory language

§264.351 Closure

At closure the owner or operator must remove all hazardous waste and hazardous waste residues (including, but not limited to, ash, scrubber waters, and scrubber sludges) from the incinerator site.

[Comment: At closure, as throughout the operating period, unless the owner or operator can demonstrate, in accordance with §261.3(d), of this Chapter, that the residue removed from the incinerator is not a hazardous waste, the owner or operator becomes a generator of hazardous waste and must manage it in accordance with applicable requirements of Parts 262 - 266 of this Chapter.]

§§264.352 - 264.999 [Reserved.]

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APPENDICES

APPENDIX A

TABLE A-1 HAZARDOUS WASTES RATED AS GOOD, POTENTIAL, OR POOR CANDIDATES
FOR INCINERATION BY APPROPRIATE TECHNOLOGIES (1-8)

EPA hazardous waste number	Generic waste number	Hazardous waste	Candidate for incineration		Incinerator type	
			Good	Potential	Liquid injection	Rotary fluidized bed
	F001	The spent halogenated solvents used in degreasing, tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and the chlorinated fluorocarbons; and sludges from the recovery of these solvents in degreasing operations.	✓		✓	✓
	F002	The spent halogenated solvents, tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, o-dichlorobenzene, trichlorofluoromethane and the still bottoms from the recovery of these solvents.	✓		✓	✓
	F003	The spent nonhalogenated solvents, xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, n-butyl alcohol, cyclohexanone, and the still bottoms from the recovery of these solvents.	✓		✓	✓
	F004	The spent nonhalogenated solvents, cresols and cresylic acid, nitrobenzene, and the still bottoms from the recovery of these solvents.	✓		✓	✓
	F005	The spent nonhalogenated solvents, methanol, toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine and the still bottoms from the recovery of these solvents.	✓		✓	✓
	F006	Wastewater treatment sludges from electroplating operations	✓	✓		
	F007	Spent plating bath solutions from electroplating operations	✓	✓		
	F008	Plating bath sludges from the bottom of plating baths from electroplating operations.	✓	✓		
	F009	Spent stripping and cleaning bath solutions from electroplating operations.	✓	✓		
	F010	Quenching bath sludge from oil baths from metal heat treating operations.	✓	✓		
	F011	Spent solutions from salt bath pot cleaning from metal heat treating operations.	✓	✓		
	F012	Quenching wastewater treatment sludges from metal heat treating operations.	✓	✓		
	F013	Flotation tallings from selective flotation from mineral metals recovery operations.	✓	✓		
	F014	Cyanidation wastewater treatment tailing pond sediment from mineral metals recovery operations	✓	✓		
	F015	Spent cyanide bath solutions from mineral metals recovery operations	✓	✓		
	F016	Devatered air pollution control scrubber sludges from coke ovens and blast furnaces.	✓	✓		
	Wood preservation					
	K001	Bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote and/or pentachlorophenol	✓			✓
	Inorganic pigments					
	K002	Wastewater treatment sludge from the production of chrome yellow and orange pigments			✓	
	K003	Wastewater treatment sludge from the production of molybdate orange pigments			✓	
	K004.	Wastewater treatment sludge from the production of zinc yellow pigments			✓	

(continued)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration		Incinerator type	
		Good	Potential	Liquid Injection	Rotary kiln
Inorganic pigments (cont'd)					
K005	Wastewater treatment sludge from the production of chrome green pigments		✓		
K006	Wastewater treatment sludge from the production of chrome oxide green pigments (anhydrous and hydrated)		✓		
K007	Wastewater treatment sludge from the production of iron blue pigments		✓		
K008	Over residue from the production of chrome oxide green pigments		✓		
Organic chemicals					
K009	Distillation bottoms from the production of acetaldehyde from ethylene		✓		
K010	Distillation side cuts from the production of acetaldehyde from ethylene		✓		
K011	Bottom stream from the wastewater stripper in the production of acrylonitrile		✓		
K012	Still bottoms from the final purification of acrylonitrile in the production of acrylonitrile		✓		
K013	Bottom stream from the acetonitrile column in the production of acrylonitrile	✓		✓	✓
K014	Bottoms from the acetonitrile purification column in the production of acrylonitrile		✓		
K015	Still bottoms from the distillation of benzyl chloride		✓		
K016	Heavy ends or distillation residues from the production of carbon tetrachloride		✓	✓	✓
K017	Heavy ends (still bottoms) from the purification column in the production of epichlorohydrin		✓		
K018	Heavy ends from fractionation of ethyl chloride production		✓		✓
K019	Heavy ends from the distillation of ethylene dichloride in ethylene dichloride production		✓		✓
K020	Heavy ends from the distillation of vinyl chloride in vinyl chloride monomer production		✓		✓
K021	Aqueous spent antimony catalyst waste from fluoromethanes production		✓		✓
K022	Distillation bottom tars from the production of phenol/acetone from cumene		✓		
K023	Distillation light ends from the production of phthalic anhydride from naphthalene	✓			✓
K024	Distillation bottoms from the production of phthalic anhydride from naphthalene		✓	✓	✓
K025	Distillation bottoms from the production of nitrobenzene by the nitration of benzene		✓		✓
K026	Stripping still tails from the production of methyl ethyl pyridines		✓		
K027	Centrifuge residue from toluene diisocyanate production		✓		
K028	Spent catalyst from the hydrochlorinator reactor in the production of 1,1,1-trichloroethane		✓		
K029	Waste from the product stream stripper in the production of 1,1,1-trichloroethane		✓		

(continued)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration		Incinerator type		
		Good	Poor	Liquid injection	Rotary kiln	Fluidized bed
Organic chemicals (cont'd)						
K030	Column bottoms or heavy ends from the combined production of trichloroethylene and perchloroethylene	✓			✓	✓
Pesticides						
K031	By-products salts generated in the production of HSHA and cacodylic acid		✓			
K032	Wastewater treatment sludge from the production of chlordane	✓				
K033	Wastewater and scrub water from the chlorination of cyclopentadiene in the production of chlordane	✓				
K034	Filter solids from the filtration of hexachlorocyclopentadiene in the production of chlordane	✓				
K035	Wastewater treatment sludges generated in the production of creosote	✓				
K036	Still bottoms from toluene reclamation distillation in the production of disulfoton	✓				
K037	Wastewater treatment sludges from the production of disulfoton	✓				
K038	Wastewater from the washing and stripping of phorate production	✓				
K039	Filter cake from the filtration of diethylphosphorothioric acid in the production of phorate	✓			✓	✓
K040	Wastewater treatment sludge from the production of phorate	✓				
K041	Wastewater treatment sludge from the production of toxaphene	✓				
K042	Heavy ends or distillation residues from the distillation of tetrachlorobenzene in the production of 2,4,5-T	✓				
K043	2,6-Dichlorophenol waste from the production of 2,4-D	✓				
Explosives						
K044	Wastewater treatment sludges from the manufacturing and processing of explosives	✓			✓	✓
K045	Spent carbon from the treatment of wastewater containing explosives	✓				
K046	Wastewater treatment sludges from the manufacturing, formulation and milling of lead-based initiating compounds		✓			
K047	Flank/ed water from TNT operations	✓			✓	✓
Petroleum refining						
K048	Dissolved air flotation (DAF) float from the petroleum refining industry	✓			✓	✓
K049	Slop oil emulsion solids from the petroleum refining industry	✓			✓	✓
K050	Heat exchanger bundle cleaning sludge from the petroleum refining industry	✓			✓	✓
K051	API separator sludge from the petroleum refining industry	✓			✓	✓
K052	Tank bottoms (leaded) from the petroleum refining industry	✓			✓	✓
Leather tanning finishing						
K053	Chrome (blue) trimmings generated by the following subcategories of the leather tanning and finishing industry; hair pulp/chrome tan/retan/wet finish; hair wave/chrome tan/retan/wet finish; retan/wet finish; no beamhouse; through-the-blue; and shearling		✓			

(continued)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration		Incinerator type	
		Good	Potential	Liquid injection	Rotary kiln bed
Leather tanning/finishing (cont'd)					
K054	Chrome (blue) shavings generated by the following subcategories of the leather tanning and finishing industry: hair pulp/chrome tan/retan/wet finish; hair save/chrome tan/retan/wet finish; retan/wet finish; no beamhouse; through-the-blue; and shearing				
K055	Buffing dust generated by the following subcategories of the leather tanning and finishing industry: hair pulp/chrome tan/retan/wet finish; hair save/chrome tan/retan/wet finish; retan/wet finish; no beamhouse; and through-the-blue				
K056	Sever screenings generated by the following subcategories of the leather tanning and finishing industry: hair pulp/chrome tan/retan/wet finish; hair save/chrome tan/retan/wet finish; retan/wet finish; no beamhouse; and shearing				
K057	Wastewater treatment sludges generated by the following subcategories of the leather tanning and finishing industry: hair pulp/chrome tan/retan/wet finish; hair save/chrome tan/retan/wet finish; retan/wet finish; no beamhouse; through-the-blue; and shearing				
K058	Wastewater treatment sludges generated by the following subcategories of the leather tanning and finishing industry: hair pulp/chrome tan/retan/wet finish; hair save/chrome tan/retan/wet finish; retan/wet finish; no beamhouse; through-the-blue and shearing				
K059	Wastewater treatment sludges generated by the following subcategories of the leather tanning and finishing industry: hair pulp/chrome tan/retan/wet finish; hair save/chrome tan/retan/wet finish; and through-the-blue				
Iron and steel					
K060	Ammonia still lime sludge from coking operations				
K061	Emission control dust/sludge from the electric furnace production of steel				
K062	Spent pickle liquor from steel finishing operations				
K063	Sludge from lime treatment of spent pickle liquor from steel finishing operations				
Primary copper					
K064	Acid plant blowdown slurry/sludge resulting from the thickening of blowdown slurry from primary copper production				
Primary lead					
K065	Surface impoundment solids contained in and dredged from surface impoundments at primary lead smelting facilities				
Primary zinc					
K066	Sludge from treatment of process wastewater and/or acid plant blowdown from primary zinc production				
K067	Electrolytic anode slimes/sludges from primary zinc production				
K068	Cathalum plant leach residue (iron oxide) from primary zinc production				

(continued)

TABLE A-1 (continued)

TABLE A-1 (continued)						
EPA hazardous waste number	Hazardous waste	Candidate for incineration	Incinerator type			
			Liquid injection	Rotary kiln fluidized bed		
Secondary lead						
R069	Emission control dust/sludge from secondary lead smelting					
Discarded commercial chemical products, off-specification species, containers, and spill residues thereof						
P001	3-(alpha-Acetylbenzyl)-4-hydroxycoumarin and salts					
P002	1-Acetyl-2-thiourea					
P003	Acrolein					
P004	Aldrin					
P005	Allyl alcohol					
P006	Aluminum phosphide					
P007	5-(Aminomethyl)-3-isoxazolol					
P008	4-Aminopyridine					
P009	Ammonium picrate					
P010	Arsenic acid					
P011	Arsenic pentoxide					
P012	Arsenic trioxide					
P013	Barium cyanide					
P014	Benzenethiol					
P015	Beryllium dust					
P016	Bis(chloromethyl) ether					
P017	Bromoacetone					
P018	Brucine					
P019	2-Butanone peroxide					
P020	2-sec-butyl-4,6-dinitrophenol					
P021	Calcium cyanide					
P022	Carbon disulfide					
P023	Chloroacetaldehyde					
P024	p-Chloroaniline					
P025	1-(p-Chlorobenzoyl)-5-methoxy-2-methylindole-3-acetic acid					
P026	1-(o-Chlorophenyl) thiourea					
P027	3-Chloropropionitrile					
P028	alpha-Chlorotoluene					
P029	Copper cyanide					
P030	Cyanides					
P031	Cyanogen					
P032	Cyanogen bromide					
P033	Cyanogen chloride					
P034	2-Cyclohexyl-4,6-dinitrophenol					
P035	2,4-Dichlorophenoxyacetic acid (2,4-D)					
P036	Dichlorophenylarsine					
P037	Dieldrin					
P038	Diethylarsine					
P039	0,0-Diethyl-S-[2-(ethylthio)ethyl] ester of phosphorothioic acid					
P040	0,0-Diethyl-S-[2-(pyrazinyl) phosphorothioate					
(continued)						

(cont. in next)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration		Incinerator type	
		Good	Potential	Liquid Injection	Rotary Altn bed
Discarded commercial chemical products, off-specification species, containers, and spill residues thereof (cont'd)					
P041	0,0-Diethyl phosphoric acid, 0-p-nitrophenyl ester	✓		✓	✓
P042	3,4-Dihydroxy-alpha-(methylamino)-methyl benzyl alcohol	✓		✓	✓
P043	Di-isopropyl fluorophosphate			✓	✓
P044	Dimethoate			✓	✓
P045	3,3-Dimethyl-1-(methylthio)-2-butanone-0-[(methylamino)carbonyl] oxime		✓	✓	✓
P046	alpha, alpha-dimethylphenethylamine	✓		✓	✓
P047	4,6-Dinitro-o-cresol and salts			✓	✓
P048	2,4-Dinitrophenol			✓	✓
P049	2,4-Dithioburet			✓	✓
P050	Endosulfan			✓	✓
P051	Endrin			✓	✓
P052	Ethylcyanide			✓	✓
P053	Ethylenediamine	✓		✓	✓
P054	Ethyleneimine	✓		✓	✓
P055	Ferric cyanide	✓		✓	✓
P056	Fluorine		✓	✓	✓
P057	2-Fluoroacetamide		✓	✓	✓
P058	Fluoroacetic acid, sodium salt		✓	✓	✓
P059	Heptachlor			✓	✓
P060	1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4:5,8-endo, endo-dimethanonaphthalene			✓	✓
P061	Hexachloropropene			✓	✓
P062	Hexamethyl tetraphosphate			✓	✓
P063	Hydrocyanic acid			✓	✓
P064	Isocyanic acid, methyl ester	✓		✓	✓
P065	Mercury fulminate			✓	✓
P066	Methoxtl		✓	✓	✓
P067	2-Methylaziridine		✓	✓	✓
P068	Methyl hydrazine	✓		✓	✓
P069	2-Methylacetoneitrile			✓	✓
P070	2-Methyl-2-(methylthio)propionaldehyde-o-(methylcarbonyl) oxime			✓	✓
P071	Methyl parathion			✓	✓
P072	1-Naphthyl-2-thiourea			✓	✓
P073	Nickel carbonyl			✓	✓
P074	Nickel cyanide			✓	✓
P075	Nicotine and salts			✓	✓
P076	Nitric oxide			✓	✓
P077	p-Nitroaniline			✓	✓
P078	Nitrogen dioxide			✓	✓
P079	Nitrogen peroxide			✓	✓
P080	Nitrogen tetroxide			✓	✓
P081	Nitroglycerine			✓	✓
P082	N-Nitrosodimethylamine	✓		✓	✓
P083	N-Nitrosodiphenylamine			✓	✓

(continued)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration		Incinerator Type	
		Good	Poor	Liquid Injection	Rotary kiln
Discarded commercial chemical products, off-specification species, containers, and spill residues thereof (cont'd)					
P004	N-Nitrosomethylvinylamine	✓			✓
P005	Octamethylpyrophosphoramide				✓
P006	Oleyl alcohol condensed with 2 moles ethylene oxide	✓		✓	✓
P007	Osmium tetroxide		✓		✓
P008	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid	✓		✓	✓
P009	Parathion		✓		✓
P010	Pentachlorophenol		✓		✓
P011	Phenyl dichloroarsine			✓	
P012	Phenylmercury acetate		✓		✓
P013	N-Phenylthiourea		✓		✓
P014	Phorate		✓		✓
P015	Phosgene		✓		✓
P016	Phosphine		✓		✓
P017	Phosphorothioic acid, O,O-dimethyl ester, O-ester with N,N-dimethyl benzene sulfonamide	✓		✓	✓
P018	Potassium cyanide		✓		✓
P019	Potassium silver cyanide		✓		✓
P100	1,2-Propanediol	✓		✓	✓
P101	Propionitrile			✓	✓
P102	2-Propyn-1-ol	✓		✓	✓
P103	Selenourea				✓
P104	Silver cyanide		✓		✓
P105	Sodium azide		✓		✓
P106	Sodium cyanide		✓		✓
P107	Sodium sulfide		✓		✓
P108	Strontium sulfide		✓		✓
P109	Strychnine and salts		✓		✓
P110	Tetraethylthiopyrophosphate		✓		✓
P111	Tetraethyl lead		✓		✓
P112	Tetraethylpyrophosphate		✓		✓
P113	Tetranitromethane		✓		✓
P114	Thallic oxide		✓		✓
P115	Thallium selenite		✓		✓
P116	Thallium (I) sulfate		✓		✓
P117	Thiosemicarbazide		✓		✓
P118	Thiuram		✓		✓
P119	Trichloroethanethiol		✓		✓
P120	Vanadic acid, ammonium salt		✓		✓
P121	Vanadium pentoxide		✓		✓
P122	Zinc cyanide		✓		✓
U001	Zinc phosphide		✓		✓
U002	Acetaldehyde	✓		✓	✓
U003	Acetone			✓	✓
	Acetonitrile		✓	✓	✓

(continued)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration			Incinerator Type	
		Good	Potential	Poor	Liquid Injection	Rotary kiln Fluidized bed
U004	Discarded commercial chemical products, off-specification species, containers, and spill residues thereof (cont'd)					
U005	Acetophenone					
U006	2-Acetylaminofluorene					
U007	Acetyl chloride					
U008	Acrylamide					
U009	Acrylic acid					
U010	Acrylonitrile					
U011	6-hydroxy-1,4,2,8,8a,8b-hexahydro-8-(hydroxymethyl)-8-methoxy-5-methylcarbamate asirino(2',3',3',4)					
U012	pyrrolid(1,2-a)indole-4,7-dione (ester)					
U013	Amitrole					
U014	Aniline					
U015	Asbestos					
U016	Auramine					
U017	Azaserine					
U018	Benz[e]acridine					
U019	Benzal chloride					
U020	Benz[a]anthracene					
U021	Benzene					
U022	Benzenesulfonyl chloride					
U023	Benzidine					
U024	Benzo[a]pyrene					
U025	Benzotrichloride					
U026	Bis(2-chloroethoxy)methane					
U027	Bis(2-chloroethyl) ether					
U028	N,N-Bis(2-chloroethyl)-2-naphthylamine					
U029	Bis(2-chloroisopropyl) ether					
U030	Bromomethane					
U031	4-Bromophenyl phenyl ether					
U032	n-Butyl alcohol					
U033	Calcium chromate					
U034	Carbonyl fluoride					
U035	Chloral					
U036	Chloroacetic acid					
U037	Chloroacetylene					
U038	Chlorobenzene					
U039	Chlorobenzilate					
U040	p-Chloro-m-cresol					
U041	Chlorodifluoromethane					
U042	1-Chloro-2,3-epoxypropane					
U043	Chloroethyl vinyl ether					
U044	Chloroethene					
U045	Chloroform					
U046	Chloromethane					

(cont. listed)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration		Incinerator type	
		Good	Potential	Liquid Injection	Rotary kiln Fluidized bed
Discarded commercial chemical products, off-specification species, containers, and spill residues thereof (cont'd)					
P064	N-Nitrosodimethylvinylamine		✓		✓
P065	Octamethylpyrophosphoramide				✓
P066	Oleyl alcohol condensed with 2 moles ethylene oxide	✓		✓	
P067	Oxium tetroxide				✓
P068	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid	✓		✓	
P069	Parathion		✓		✓
P070	Pentachlorophenol		✓		✓
P071	Phenyl dichloroarsine				✓
P072	Phenylmercury acetate			✓	✓
P073	N-Phenylthiourea		✓		✓
P074	Phorate		✓		✓
P075	Phosgene		✓		✓
P076	Phosphine				✓
P077	Phosphorothioic acid, O,O-dimethyl ester, O-ester with N,N-dimethyl benzene sulfonamide		✓	✓	
P078	Potassium cyanide				✓
P079	Potassium silver cyanide	✓		✓	✓
P100	1,2-Propanediol				✓
P101	Propionitrile	✓		✓	✓
P102	2-Propyn-1-ol				✓
P103	Selenourea		✓		✓
P104	Silver cyanide				✓
P105	Sodium azide		✓		✓
P106	Sodium cyanide		✓		✓
P107	Strontium sulfide		✓		✓
P108	Strychnine and salts		✓		✓
P109	Tetraethylthiopyrophosphate			✓	✓
P110	Tetraethyl lead		✓	✓	✓
P111	Tetraethylpyrophosphate		✓		✓
P112	Tetranitromethane				✓
P113	Thallic oxide				✓
P114	Thallium selenite				✓
P115	Thallium (I) sulfate		✓		✓
P116	Thiosemicarbazide		✓		✓
P117	Thiuram				✓
P118	Trichloroethanethiol				✓
P119	Vanadic acid, ammonium salt				✓
P120	Vanadium pentoxide				✓
P121	Zinc cyanide				✓
P122	Zinc phosphide				✓
U001	Acetaldehyde	✓		✓	✓
U002	Acetone		✓		✓
U003	Acetonitrile				✓

(continued)

(continued)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration		Incinerator type	
		Good	Poor	Liquid Injection	Rotary Fluidized bed
Discarded commercial chemical products, off-specification species, containers, and spill residues thereof (cont'd)					
P004	N-Nitrosomethylvinylamine				
P005	Octamethylpyrophosphoramide				
P006	Oil/alcohol condensed with 2 moles ethylene oxide				
P007	Oxamium tetraoxide				
P008	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid				
P009	Parathion				
P010	Pentachlorophenol				
P011	Phenyl dichloroarsine				
P012	Phenylmercury acetate				
P013	N-Phenylthiourea				
P014	Phorate				
P015	Phosgene				
P016	Phosphine				
P017	Phosphorothioic acid, O,O-dimethyl ester, O-ester with N,N-dimethyl benzene sulfonamide				
P018	Potassium cyanide				
P019	Potassium silver cyanide				
P100	1,2-Propanediol				
P101	Propionitrile				
P102	2-Propyn-1-ol				
P103	Selenourea				
P104	Silver cyanide				
P105	Sodium azide				
P106	Sodium cyanide				
P107	Strontium sulfide				
P108	Strychnine and salts				
P109	Tetraethylthiopyrophosphate				
P110	Tetraethyl lead				
P111	Tetraethylpyrophosphate				
P112	Tetraethylene				
P113	Thallic oxide				
P114	Thallium selenite				
P115	Thallium (I) sulfate				
P116	Thiosemicarbazide				
P117	Thiuron				
P118	Trichloromethanethiol				
P119	Vanadic acid, ammonium salt				
P120	Vanadium pentoxide				
P121	Zinc cyanide				
P122	Zinc phosphide				
U001	Acetaldehyde				
U002	Acetone				
U003	Acetonitrile				

(cont. Inued)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration		Incinerator type	
		Good	Potential	Liquid injection	Rotary Fluidized bed
Discarded commercial chemical products, off-specification species, containers, and spill residues thereof (cont'd)					
U089	Diethylstilbestrol	✓			✓
U090	Dihydrostilbestrol	✓			✓
U091	3,3'-Dimethoxybenzidine	✓			✓
U092	Dimethylamine	✓			✓
U093	p-Dimethylaminobenzene	✓			✓
U094	7,12-Dimethylbenz[a]anthracene	✓			✓
U095	3,3'-Dimethylbenzidine	✓			✓
U096	alpha-alpha-Dimethylbenzylhydroperoxide	✓			✓
U097	Dimethylcarbamoyl chloride	✓			✓
U098	1,1-Dimethylhydrazine	✓			✓
U099	1,2-Dimethylhydrazine	✓			✓
U100	Dimethylnitrosamine	✓			✓
U101	2,4-Dimethylphenol	✓			✓
U102	Dimethyl phthalate	✓			✓
U103	Dimethyl sulfate	✓			✓
U104	2,4-Dinitrophenol	✓			✓
U105	2,4-Dinitrotoluene	✓			✓
U106	2,6-Dinitrotoluene	✓			✓
U107	Di-n-octyl phthalate	✓			✓
U108	1,4-Dioxane	✓			✓
U109	1,2-Diphenylhydrazine	✓			✓
U110	Diethylamine	✓			✓
U111	Di-n-propylnitrosamine	✓			✓
U112	Ethyl acetate	✓			✓
U113	Ethyl acrylate	✓			✓
U114	Ethylenebis(dithiocarbamate)	✓			✓
U115	Ethylene oxide	✓			✓
U116	Ethylene thiourea	✓			✓
U117	Ethyl ether	✓			✓
U118	Ethylmethacrylate	✓			✓
U119	Ethyl methanesulfonate	✓			✓
U120	Fluoranthene	✓			✓
U121	Fluorotrichloromethane	✓			✓
U122	Formaldehyde	✓			✓
U123	Formic acid	✓			✓
U124	Furan	✓			✓
U125	Furfural	✓			✓
U126	Glycidylaldehyde	✓			✓
U127	Hexachlorobenzene	✓			✓
U128	Hexachlorobutadiene	✓			✓
U129	Hexachlorocyclopentadiene	✓			✓
U130	Hexachlorocyclopentadiene	✓			✓

(cont Inued)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration		Incinerator type	
		Good	Poor	Liquid Injection	Rotary kiln Fluidized bed
Discarded commercial chemical products, off-specification species, containers, and spill residues thereof (cont'd)					
U046	Chloromethyl methyl ether				
U047	2-Chloronaphthalene				
U048	2-Chlorophenol				
U049	4-Chloro-o-toluidine hydrochloride				
U050	Chrysene				
U051	Cresote				
U052	Cresols				
U053	Crotonaldehyde				
U054	Cresylic acid				
U055	Cumene				
U056	Cyclohexane				
U057	Cyclohexanone				
U058	Cyclophosphamide				
U059	Daucomycin				
U060	DDP				
U061	DDT				
U062	Diallate				
U063	Dibenz[a,h]anthracene				
U064	Dibenz[a,i]pyrene				
U065	Dibromochloromethane				
U066	1,2-Dibromo-3-chloropropane				
U067	1,2-Dibromomethane				
U068	Dibromomethane				
U069	Di-n-butyl phthalate				
U070	1,2-Dichlorobenzene				
U071	1,3-Dichlorobenzene				
U072	1,4-Dichlorobenzene				
U073	3,3'-Dichlorobenzidine				
U074	1,4-Dichloro-2-butene				
U075	Dichlorodifluoromethane				
U076	1,1-Dichloroethane				
U077	1,2-Dichloroethane				
U078	1,1-Dichloroethylene				
U079	1,2-trans-dichloroethylene				
U080	Dichloromethane				
U081	2,4-Dichlorophenol				
U082	2,6-Dichlorophenol				
U083	1,2-Dichloropropane				
U084	1,3-Dichloropropane				
U085	Dipoxylutane				
U086	1,2-Diethylhydrazine				
U087	O,O-Diethyl-S-methyl ester of phosphorodithioic acid				
U088	Diethyl phthalate				

(cont. Inued)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration		Incinerator type	
		Good	Poor	Liquid injection	Rotary fluidized bed
Discarded commercial chemical products, off-specification species, containers, and spill residues thereof (cont'd)					
U005	Diethylstilbestrol	✓			✓
U090	Dihydroarsinic acid	✓			✓
U091	3,3'-Dimethoxybenzidine	✓			✓
U092	Dimethylamine	✓			✓
U093	p-Dimethylaminobenzene	✓			✓
U094	7,12-Dimethylbenz[a]anthracene	✓			✓
U095	3,3'-Dimethylbenzidine	✓			✓
U096	alpha-alpha-Dimethylbenzylhydroperoxide	✓			✓
U097	Dimethylcarbamoyl chloride	✓			✓
U098	1,1-Dimethylhydrazine	✓			✓
U099	1,2-Dimethylhydrazine	✓			✓
U100	Dimethyl nitrosamine	✓			✓
U101	2,4-Dimethylphenol	✓			✓
U102	Dimethyl phthalate	✓			✓
U103	Dimethyl sulfate	✓			✓
U104	2,4-Dinitrophenol	✓			✓
U105	2,4-Dinitrotoluene	✓			✓
U106	2,6-Dinitrotoluene	✓			✓
U107	Di-n-octyl phthalate	✓			✓
U108	1,4-Dioxane	✓			✓
U109	1,2-Diphenylhydrazine	✓			✓
U110	Dipropylamine	✓			✓
U111	Di-n-propylnitrosamine	✓			✓
U112	Ethyl acetate	✓			✓
U113	Ethyl acrylate	✓			✓
U114	Ethylenebis(dithiocarbamate)	✓			✓
U115	Ethylene oxide	✓			✓
U116	Ethylene thiourea	✓			✓
U117	Ethyl ether	✓			✓
U118	Ethylmethacrylate	✓			✓
U119	Ethyl methanesulfonate	✓			✓
U120	Fluoranthene	✓			✓
U121	Fluorotrichloromethane	✓			✓
U122	Formaldehyde	✓			✓
U123	Formic acid	✓			✓
U124	Furan	✓			✓
U125	Furfural	✓			✓
U126	Glycidylaldehyde	✓			✓
U127	Hexachlorobenzene	✓			✓
U128	Hexachlorobutadiene	✓			✓
U129	Hexachlorocyclohexane	✓			✓
U130	Hexachlorocyclopentadiene	✓			✓

(cont. Inured)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration		Incinerator type	
		Good	Poor	Liquid	Rotary
				Injection	kiln
Fluidized bed					
Discarded commercial chemical products, off-specification species, containers, and spill residues thereof (cont'd)					
U131	Hexachloroethane	✓			✓
U132	Hexachlorobenzene	✓			✓
U133	Hydrazine	✓		✓	✓
U134	Hydrofluoric acid	✓			✓
U135	Hydrogen sulfide		✓		
U136	Hydroxydiethyl arsine oxide				✓
U137	Indeno(1,2,3-cd)pyrene	✓		✓	✓
U138	Iodomethane				✓
U139	Iron Dextran		✓		
U140	Isobutyl alcohol	✓		✓	✓
U141	Isosafrole	✓		✓	✓
U142	Ketone	✓			✓
U143	Laslocarpine		✓		
U144	Lead acetate				✓
U145	Lead phosphate				✓
U146	Lead subacetate				✓
U147	Maleic anhydride	✓			✓
U148	Maleic hydrazide	✓			✓
U149	Malonitrile	✓			✓
U150	Melphalan	✓			✓
U151	Mercury		✓		
U152	Methacrylonitrile	✓			✓
U153	Methanethiol	✓			✓
U154	Methanol				✓
U155	Methacrylene	✓			✓
U156	Methyl chlorocarbonate				✓
U157	3-Methylcholanthrene	✓			✓
U158	4,4'-Methylene-bis-(2-chloroaniline)	✓			✓
U159	Methyl ethyl ketone	✓			✓
U160	Methyl ethyl ketone peroxide	✓			✓
U161	Methyl isobutyl ketone	✓			✓
U162	Methyl methacrylate	✓			✓
U163	N-Methyl-N'-nitro-N-nitrosoguanidine	✓			✓
U164	Nethylthiourea				✓
U165	Naphthalene	✓			✓
U166	1,4-Naphthoquinone	✓			✓
U167	1-Naphthylamine				✓
U168	2-Naphthylamine				✓
U169	Nitrobenzene				✓
U170	4-Nitrophenol	✓			✓
U171	2-Nitropropane	✓			✓
U172	N-Nitrosodi-n-butylamine				✓
U173	N-Nitrosodietanolamine				✓

(continued)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration			Incinerator type	
		Good	Potential	Poor	Liquid Injection	Rotary kiln Fluidized bed
	Discarded commercial chemical products, off-specification species, containers, and spill residues thereof (cont'd)					
U174	N-Nitrosodimethylamine					
U175	N-Nitrosodi-n-propylamine					
U176	N-Nitrosodi-n-ethylurea					
U177	N-Nitroso-n-methylurea					
U178	N-Nitroso-n-methylurethane					
U179	N-Nitrosopiperidine					
U180	N-Nitrosopyrrolidine					
U181	5-Nitro-o-toluidine					
U182	Peraldehyde					
U183	Pentachlorobenzene					
U184	Pentachloroethane					
U185	Pentachloronitrobenzene					
U186	1,3-Pentadiene					
U187	Phenacetin					
U188	Phenol					
U189	Phosphorous sulfide					
U190	Phthalic anhydride					
U191	2-Picoline					
U192	Propanol					
U193	1,3-Propene sulfone					
U194	n-Propylamine					
U195	Pyridine					
U196	Quinone					
U197	Reserpine					
U200	Resorcinol					
U201	Saccharin					
U202	Safrole					
U203	Selenious acid					
U204	Selenium sulfide					
U205	Streptozotocin					
U206	1,2,4,5-Tetrachlorobenzene					
U207	1,1,1,2-Tetrachloroethane					
U208	1,1,2,2-Tetrachloroethane					
U209	Tetrachloroethane					
U210	Tetrachloroethane					
U211	2,2,6,6-Tetrachlorophenol					
U212	Tetrahydrofuran					
U213	Thallium acetate					
U214	Thallium carbonate					
U215	Thallium chloride					
U216	Thallium nitrate					
U217	Thioacetamide					
U218	Thiourea					

(continued)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration		Incinerator type	
		Good	Potential	Liquid Injection	Notary Fluidized kiln + bed
Discarded commercial chemical products, off-specification species, containers, and spill residues thereof (cont'd)					
U220	Toluene	✓		✓	✓
U221	Toluenediamine		✓	✓	✓
U222	o-Toluidine hydrochloride		✓	✓	✓
U223	Toluene diisocyanate		✓	✓	✓
U224	Toxaphene		✓	✓	✓
U225	Tribromomethane		✓	✓	✓
U226	1,1,1-Trichloroethane		✓	✓	✓
U227	1,1,2-Trichloroethane		✓	✓	✓
U228	Trichloroethane		✓	✓	✓
U229	Trichlorofluoromethane		✓	✓	✓
U230	2,4,5-Trichlorophenol		✓	✓	✓
U231	2,4,6-Trichlorophenol		✓	✓	✓
U232	2,4,5-Trichlorophenoxyacetic acid		✓	✓	✓
U233	2,4,5-Trichlorophenoxypropionic acid		✓	✓	✓
U234	Trinitrobenzene		✓	✓	✓
U235	Tris(2,3-dibromopropyl) phosphate		✓	✓	✓
U236	Trypan blue		✓	✓	✓
U237	Uracil mustard		✓	✓	✓
U238	Urethane		✓	✓	✓
U239	Xylene		✓	✓	✓
Other hazardous wastes					
SIC code number					
2065	Vacuum still bottoms from the production of maleic anhydride	✓		✓	✓
2065	Distillation residues from fractionating tower for recovery of benzene and chlorobenzenes		✓	✓	✓
2065	Vacuum distillation residues from purification of 1-chloro-4-nitrobenzene		✓	✓	✓
2065	Still bottoms or heavy ends from methanol recovery in methyl methacrylate production	✓	✓	✓	✓
2069	Heavy ends and distillation from production of carbaryl			✓	✓
2069	Residues from the production of hexachlorophenol, trichlorophenol and 2,4,5-T	✓	✓	✓	✓
2069	Heavy ends from distillation of ethylene dichloride in vinyl chloride production		✓	✓	✓
2069	Solid waste discharge from ion exchange column in production of acrylonitrile		✓	✓	✓
2069	Bottom stream from quench column in acrylonitrile production of acrylonitrile		✓	✓	✓
2069	Still bottoms from aniline production	✓	✓	✓	✓
2069	Tars from manufacture of bicycloheptadiene and cyclopentadiene	✓	✓	✓	✓
2069	Still bottom from production of furfural	✓	✓	✓	✓
2069	Unrecovered triester from production of diisulfon	✓	✓	✓	✓
2295	Waste polyvinyl chloride (PVC) from the manufacture of coated fabrics	✓	✓	✓	✓
2069	Still bottoms from the production of pentachloronitrobenzene	✓	✓	✓	✓

(continued)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration		Incinerator type	
		Good	Potential	Liquid Injection	Rotary kiln Fluidized bed
Other hazardous wastes (cont'd)					
SIC code number					
2869	Process clean out sludges from production of 1,1,1-trichloroethane		✓	✓	✓
2869	Heavy ends and light ends from the production of methyl acrylate			✓	✓
2822	Polyvinyl chloride sludge from the manufacture of polyvinyl chloride	✓		✓	✓
2869	Still bottoms from the purification of fluoromethanes in the production of fluoromethanes		✓		✓
2869	Heavy ends and light ends from the production of ethyl acrylate	✓		✓	✓
2869	Heavy ends from the production of glycerine from allyl chloride	✓		✓	✓
2869	Heavy ends from the distillation of acetic anhydride in the production of acetic anhydride	✓		✓	✓
2869	Light ends from the distillation of acetaldehyde in the production of acetic anhydride	✓		✓	✓
	• Reactor cleanup wastes from the chlorination, dehydrochlorination or oxychlorination of aliphatic hydrocarbons		✓	✓	✓
	• Fractionation bottoms from the separation of chlorinated aliphatic hydrocarbons		✓	✓	✓
	• Distillation bottoms from the separation of chlorinated aliphatic hydrocarbons		✓	✓	✓
	• Reactor cleanup wastes from the chlorination or oxychlorination of cyclic aliphatic hydrocarbons		✓	✓	✓
	• Fractionation bottoms from the separation of chlorinated cyclic aliphatic hydrocarbons		✓	✓	✓
	• Distillation bottoms from the separation of chlorinated cyclic aliphatic hydrocarbons		✓	✓	✓
	• Batch residues from the batch production of chlorinated polymers		✓	✓	✓
	• Solution residues from the production of chlorinated polymers		✓	✓	✓
	• Reactor cleanup wastes from the chlorination of aromatic hydrocarbon		✓	✓	✓
	• Fractionation bottoms from the separation of chlorinated aromatic hydrocarbons		✓	✓	✓
	• Distillation bottoms from the separation of chlorinated aromatic hydrocarbons		✓	✓	✓
3333	Zinc production; oxide furnace residue and acid plant sludge			✓	✓
3339	Ferromanganese emissions control; baghouse dusts and scrubwater solids			✓	✓
3339	Ferrosilicon silicon furnace emission control dust or sludge			✓	✓
3339	Ferrosilicon emissions control; furnace baghouse dust, and ESP			✓	✓
3339	Primary antimony-pyrometallurgical blast furnace slag			✓	✓
3341	Secondary lead, scrubber sludge from SO ₂ emission control, soft lead production			✓	✓

(continued)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration		Incinerator type	
		Good	Potential	Liquid injection	Rotary fluidized bed
Other hazardous wastes (cont'd)					
SIC code number					
3341	Secondary lead-white metal production furnace dust				
3341	Secondary copper-pyrometallurgical, blast furnace slag	✓			
3341	Secondary copper-electrolytic refining wastewater treatment sludge	✓			
3341	Secondary aluminum dross smelting-high salt slag plant residue	✓			
3341	Zinc-cadmium metal reclamation, cadmium plant residue	✓			
3691	Lead acid storage battery production wastewater treatment sludges	✓			
3691	Lead acid storage battery production cleanup wastes from cathode and anode paste production	✓			
3691	Nickel cadmium battery production wastewater treatment sludges	✓			
3691	Cadmium silver oxide battery production wastewater treatment sludges	✓			
3691	Mercury cadmium battery production wastewater treatment sludges	✓			
3692	Magnesium carbon battery production chromic acid wastewater treatment sludges	✓			
2816	Ash from incinerated still bottoms (paint and pigment production)	✓			
2819	Arsenic bearing wastewater treatment sludges from production of boric acid	✓			
2834	Arsenic or organo-arsenic containing wastewater treatment sludges from production of veterinary pharmaceuticals	✓			
2851	Wastewater treatment sludges from paint production	✓			
2851	Air pollution control sludges from paint production	✓			
2869	By-product salts in production of MSMA	✓			
2869	By-product salts in production of cacodylic acid	✓			
2869	Lead slag from lead alkyl production	✓			
3312	Steel finishing, Alkaline cleaning waste	✓			
	• Waste pickle liquor				
	• Cyanide-bearing wastes from electrolytic coating				
	• Chromate and dichromate wastes from chemical treatment				
	• Descaling acid				
3322	Lead/phenolic sand-casting waste from malleable iron foundries	✓			
3331	Primary copper smelting and refining electric furnace slag, converter dust, acid plant sludge, and reverberatory dust (T)	✓			
3332	Primary lead blast furnace dust	✓			
3339	Primary antimony-electrolytic sludge	✓			
3339	Primary tungsten-digestion residue	✓			
1094	Waste rock and overburden from uranium mining	✓			
1099	Chlorinator residues and clarifier sludge from zirconium extraction	✓			
1475	Overburden and slimes from phosphate surface mining	✓			
2874	Waste gypsum from phosphoric acid production	✓			
2819-2874	Slag and fluid bed pills from elemental phosphorus production	✓			
2812	Sodium calcium sludge from production of chlorine by Down Cell process	✓			
2812	Mercury bearing brine purification muds from mercury cell process in chlorine production	✓			

(cont. Inset)

TABLE A-1 (continued)

EPA hazardous waste number	Hazardous waste	Candidate for incineration		Incinerator type	
		Good	Potential	Liquid injection	Rotary kiln fluidized bed
<u>Other hazardous wastes (cont'd)</u>					
SIC code number					
2816	Mercury bearing wastewater treatment sludges from the production of mercuric sulfide pigment				
2816	Chromium bearing wastewater treatment sludges from the production of TiO ₂ pigment by the chloride process			✓	
2816	Arsenic bearing sludges from purification process in the production of antimony oxide			✓	
2816	Antimony bearing wastewater treatment sludge from production of antimony oxide			✓	
3312	Iron making; Ferromanganese blast furnace dust			✓	
	• Ferromanganese blast furnace sludge				
	• Electric furnace dust and sludge				

*Use this table for indicative guidance only. For decision making, read the material presented in the text.

APPENDIX B

Telecon
w/Doug Cooper
Rollins E. S.
Deer Park, Tx.

10/23/80

Texas Air Control Bd. requires at least 1 stack test/yr. - thus far in 1980 there have been 4-5 such tests, for various reasons.

All tests show 99+% on HCl recovery in scrubber. Latest test September 80 showed 99.95% recovery of HCl.

Texas Air Control Board requires maximum emissions of 10#/hr., HCl or 40#/hr. Cl_2 from any incinerator. Knowing nature of wastes to be handled in southern Texas, Rollins installed scrubber via management decision.

Also, TRW report is incorrect in that dil. lime slurry was used in test burns run @ Rollins, not water.

Telecon
w/John Trapp
Cincinatti Munic. Incin.

10/23/80

EPA tests run 2 months ago.

Had difficulty in stack gas analysis, using Bendix detector tubes.

No HCl or Cl₂ detected in stack gas although waste feed analyzed 2.5% Cl₂ (organic Cl₂). Pre-scrubber gas analysis showed HCl but below theory predicted by waste analysis. Sampling and test work by Pollution Control Sciences, Inc.

DE on organics was 99.5%.

Desires good HCl method if any known??

Planned scrubber installation on basis of waste expected to be burned but there was and is no legal requirement.

To work w/a Mr. Freeman of EPA (Cinn.) on a dry run exercise for obtaining an EPA permit to operate the Cincinatti L/F I Waste Disposal facility.

Telecon

Date: 10/24/80

George Thomas
Eastman Kodak
716-722-2363
Engr. & Envir. Tech. Services
Rochester, N.Y.

Unit has a large capacity, hi-energy (60" H₂O P) venturi scrubber. "E" never tested across scrubber, but stack gas consistently shows < 7.5 lb/hr Cl, which is N.Y. State requirement. Waste loading is equivalent to 100-200 ppH of HCl. (Thus, E = 92-97%) They have not, and do not know how to sample for HCl in the hot zone. They use EPA Method 5 for stack samplings, with dilute NaOH in the gas impingers of the anal. equipment. There are small, but unknown quantities of Br & I in the stack, but there are no limitations on these emissions. E.K. is working with the state on possible I₂ and Br₂ emission limits. The venturi scrubber uses a dilute NaOH scrubbing medium.

Telecon

10/24/80

Jim A. Mullins
Shell Chemical Co.
Houston, Texas
713-241-2723

AM Shell has operations in Tx and La which require scrubbers. The Tx operation have one older incinerator which handles liquid chlorinated HC wastes (and which can accept gaseous wastes also), and two newer units which operate only on gaseous wastes from chlor. HC operations such as VC. The vapor units have scrubbers which are composed of 2 sections. Each lower section uses water as the scrubbing medium, and each upper (cleanup) section uses dil. caustic soda. *(See p. 5.) There have been some concerns by Shell regarding free Cl_2 which has also been detected. However, the principal concern in the past was that of opacity of stack plume. The plant complex also emits NH_3 gas and amines, and any free HCl combines with these compounds to form an objectionable and visible air pollutant. Thus, Shell tries to operate with HCl emissions of no greater than 5 ppm. Shell's permit from T.A.C.B. requires BAT for the units, but total HCl and Cl_2 emissions are regulated from their complex (sort of a "bubble" concept), as opposed to an individual emission requirement.

In La., there are 2 incin. units: one for combined liq and vapor wastes from chlor. HC operations, and one for vapor wastes, only. The vapor unit has a complete back-up unit, so that the chem. process operations will not be shut down by an incin. failure. La. has no HCl emission reqmts., and each unit has to pass

the state permitting authority. However, U.S. regulations on VCM emissions do apply and override. BAT is specified. All La. units use Mississippi river water (which happens to be slightly alkaline) as scrubber medium. **(See p. 5.)

Mr. Mullins will call again in answer to my questions, re:

- (a) Scrubber E.
- (b) Any problems of sampling for HCl in hot zone prior to scrubber.
- (c) Reliability and method of HCl analysis.
- (d) Any difference between hot zone, HCl analysis, and estimated conc. HCl based on waste feed analysis.

* Correction to p. 2. The liq. incin. in Tx has a 3-stage scrubber, each stage using H₂O.

** The liq. incin. in La. has a 3-stage quench, which uses:
(a) H₂O, (b) dil. caustic soda, and (c) Miss. river water.
This incin. had been giving off considerable mist, and the demister did not work well. The 3rd stage scrubber, using river water, was then installed as a demister. It utilizes large quantities of water and does demist. satisfactorily.

Thermodynamic equilibrium calculations show 1000 ppm Cl₂ in gases from the incinerator, and Cl₂ is therefore removed in the La. liq. unit, and in all vapor units using proprietary technology. Licensed technology is used to remove Cl₂ at the Tx liq. unit.

All scrubbers have 99% E or better. Calculations for E are based on Cl analysis of feed to the units, and there is no hot gas sampling. On a recent test of the Tx liq. unit, stack gases analyzed 40-50 ppm Cl₂ and 22 ppm HCl. Feed to this unit is 65% Cl, by weight.

A comment was also made that HCl emission seems to correlate with escape of metal particulates.

Scrubber Data from
"Destroying Chemical Wastes in
Commercial-Scale Incinerators"
Facility Report No. 5
USEPA 1977

by A. D. Little Co.

Test runs made on Chemolite Inc. System at 3 M Co. @ Cottage Grove, Minn. System consists of rotary kiln, secondary combustion chamber, quench elbow and quench chamber, hi energy venturi scrubber, sieve tower, demister, 500 hp fan, and stack. Wastes burned were from PVC plants, and consisted of 28% solids (mostly PVC) and 72 H₂O. Btu rating of the unit is 90×10^6 Btu/hr.

HCl in the combustion gas analyzed 1485-1660 mg/m³. Water is scrubber liquor. In two closely monitored runs, scrubber efficiency was 99.1% and 99.3%.

I. Frankel
11/14/80

APPENDIX C



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

June 5, 1980

OFFICE OF
GENERAL COUNSEL

MEMORANDUM

SUBJECT: Regulating Hazardous Waste Incineration

FROM: Michael Dworkin *MD*
Attorney
Water and Solid Waste Division (A-131)

TO: Ed Martin
Program Manager
Hazardous & Industrial Waste Division (WH-565)

I have attached the consent decree in the Rollins' incinerator case. The technical details begin at the end of page 3. They include, temperature, waste lists, inflow and temperature recording criteria, monitoring and alarm requirements, and automatic cut off devices. They are all significant, but I am especially interested in the list of "priority waste". How does that compare to Walt Barber's idea for specific listed wastes? The decree was sent to me by Bill Freeman in Region II's Enforcement Division. He suggested that Mike Pucchi was the engineer who had developed the technical standards.

Steve Silverman has given me the names of two people who were very helpful to him in predicting the health consequences of incomplete or partial combustion of various toxic wastes. One is Forrest Nixon, (919) 541-5917. Silverman thinks he works for Research Triangle Institute (?), an EPA contractor. The other is Dr. Dwayne Nichols (919) 541-6155 in Raleigh, North Carolina. Both of them have apparently worked with Walt Barber in the past on predicting and modeling air effects of hazardous waste incineration.

Attachment

UNITED STATES DISTRICT COURT
DISTRICT OF NEW JERSEY

		x
UNITED STATES OF AMERICA	:	<u>JUDGMENT ON CONSENT</u>
Plaintiff,	:	Civil Action No.
v.	:	
ROLLINS ENVIRONMENTAL SERVICES (NJ) :	:	
INC.	:	
Defendant.	:	
		x

WHEREAS, pursuant to Sections 108 and 109 of the Clean Air Act ("the Act"), 42 U.S.C. §§7409, the Administrator of the U.S. Environmental Protection Agency ("EPA") has established air quality criteria for specified pollutants, and promulgated national ambient air quality standards for pollutants for which such criteria were established; and

WHEREAS, pursuant to Section 107 of the Act, 42 U.S.C. §7407, air quality control regions have been designated throughout the country; and

WHEREAS, Section 110 of the Act, 42 U.S.C. §7410, mandates that state implementation plans shall be promulgated to provide for the implementation, maintenance and enforcement of air quality standards in each air quality control region (or portion thereof) within each state, and the New Jersey State Implementation Plan ("SIP") has been promulgated to comply with the mandate of Section 110; and

WHEREAS, a regulation setting emission standards for incinerators, modified in Title 7, Chapter 27, Section 11.3(b)(2) of the New Jersey Administrative Code (N.J.A.C. 7:27-11.3(b)(2)) has been promulgated and is part of the SIP and is applicable to the air quality control region in which Defendant Rollins Environmental Services (NJ) Inc.'s ("Rollins") Bridgeport, New Jersey facility is located; and

WHEREAS, The EPA issued a Notice of Violation on June 9, 1977 pursuant to Section 113(a)(1) of the Act, 42 U.S.C. §7413 (a)(1) finding an incinerator operated by Rollins at its Bridgeport, New Jersey facility ("the incinerator") to be in violation of N.J.A.C. 7:27-11.3(b)(2); and

WHEREAS, pursuant to Section 113(a)(4) of the Act, 42 U.S.C. §7413(a)(4), conferences were held on September 23, 1977 and April 5, 1978 between representatives of Rollins and EPA concerning the above-cited alleged violation; and

WHEREAS, on November 28, 1978, EPA and Rollins entered into a Consent Order (Index No. 70131) pursuant to Section 113(a)(1) of the Act, 42 U.S.C. §7413(a)(1), wherein Rollins acknowledged that it was in violation of the requirements of N.J.A.C. 7:27-11(b)(2) on April 7, 1977 and for a period extending beyond thirty (30) days after its receipt of the above-mentioned Notice of Violation, and wherein Rollins consented to the issuance of said Consent Order and to its terms; and

WHEREAS, the above-mentioned Consent Order set forth certain requirements that were reasonably calculated to ensure that

emissions from Rollins' Bridgeport incinerator would comply with the requirements of N.J.A.C. 7:27-11.3(b)(2); and

WHEREAS, the above-mentioned Consent Order required that Rollins submit monthly reports to EPA containing temperature data on its incinerator and certain other information on the operation of its incinerator; and

WHEREAS, Rollins' above-mentioned monthly reports indicated that during the months of February, March, April, May, June, July and August, 1979, operations at Rollins' incinerator were in violation of certain requirements of the above-mentioned Consent Order from time to time; and

WHEREAS, at all times Rollins' representatives have comported themselves in a forthright manner, and have demonstrated a willingness to cooperate with EPA in arriving at a prompt and equitable resolution of these proceedings; and

WHEREAS, Rollins' Bridgeport incinerator is a "major stationary source" as that term is defined in Section 302(j) of the Act, 42 U.S.C. §7602(j); and

WHEREAS, pursuant to Section 113(b) of the Act, 42 U.S.C. §7413(b), the Administrator of EPA (or his delegate) is mandated to commence a civil action for appropriate relief whenever the owner or operator of a major stationary source violates any order issued under Section 113(a) of the Act, 42 U.S.C. §7413(a); and

WHEREAS, any action under Section 113(b) of the Act, 42 U.S.C. §7413(b), is to be brought in the district court of the United States for the district in which the violation occurred

or in which the defendant resides or has his principal place of business, 42 U.S.C. §7413(b); and

WHEREAS, the above-cited violation occurred in the judicial district over which this Court has jurisdiction; and

WHEREAS, the parties to this action believe that the terms of this Judgment will, in combination with actions taken and to be taken by the New Jersey Department of Environmental Protection, have the effect of preventing hazards to health or the environment attributable to improper incineration at the Rollins facility; and

WHEREAS, EPA and Rollins, by their respective attorneys, have each consented to the making and entering of this Judgment permanently enjoining and restraining defendant as specified herein, assessing a civil penalty as provided herein, and establishing a scheme for liquidated penalties for any future violations of the terms of this Judgment, and the Court, without trial or adjudication of any issues of fact or law, has considered the matter and has been advised, it is hereby

ORDERED, ADJUDGED AND DECREED as follows:

I. This Court has jurisdiction of the subject matter of this action and of the parties hereto. This action arises under Section 113 of the Act 42 U.S.C. §7413, and 28 U.S.C. §§1331, 134 and 1355. The complaint filed in this action states a claim upon which relief can be granted.

II. By no later than thirty days after the date of this Judgment, Rollins shall pay by cashier's or certified check

payable to the Treasurer, United States of America, a civil penalty in the amount of sixty five thousand dollars (\$65,000.00) in full satisfaction of all liabilities which have been incurred by defendant for the violation of the above-mentioned Consent Order which occurred prior to the date of this Judgment. Such payment shall be remitted to the Assistant Attorney General, Division of Lands and Natural Resources, U.S. Department of Justice, Washington, D.C. 20530.

III. The above-mentioned administrative Consent Order (Index No. 70131) is hereby superseded by the following provisions of this Judgment:

Immediately upon the date of entry of this Judgment, and at all times thereafter, Rollins shall conform its incineration operations at the Bridgeport, New Jersey facility to the following requirements:

(A) When the incinerator temperature is below 600° F as measured at the hot duct, no wastes shall be incinerated. Below 600° F only commercially-available fuel shall be incinerated.

(B) "Priority Wastes" are hereby defines as follows:

- (1) Any wastes, waste mixture, or waste stream containing a concentration of greater than 1.0% (in the aggregate) of the following substances:

Aromatic Amines

Halogenated Hydrocarbons

Benzene

Cyano Wastes (both organic and inorganic)

Cyclohexane
Dimethyl Terephthalate
Ethylene Amine
Herbicides
Pesticides
Polycyclic Aromatics
1,4 Dioxane

(2) All wastes, waste mixtures or waste streams fed to the incinerator which have not been analyzed using gas chromatography-mass spectroscopy and shown to contain less than 1.0% by weight (in the aggregate) of the substances or classes of substances listed in Subparagraph (1) of this Paragraph, above.

(3) The contents of all drums and other bulk material fed to the kiln.

(C) Priority Wastes shall be incinerated only at temperatures above 1800° F (or such other higher temperature as shall be required by the New Jersey Department of Environmental Protection), with a dwell time of two seconds or greater, as calculated in accordance with EPA Sampling Methods and Analytical Procedures Manual for PCB Disposal, Interim Report, February 10, 1978, Section 4.2.

However, during the period specified in Paragraph (A) of Section IV of this Judgment, below, it shall not be considered a violation of this Judgment on Consent if Priority Wastes are incinerated; for no more than ten minutes duration at temperatures 1750° F and 1800° F, or for no more than five minutes duration at

less than 1750° F. Nor shall it be considered a violation of this Judgment if Priority Wastes are incinerated for no more than three minutes duration at less than 1800° F thereafter. Provided however, that in no event shall Priority Wastes be used to bring the temperature in the hot duct up to 1800° F during start-up or following a temperature drop condition, for which purposes only commercially-available fuel or non-Priority Wastes may be used.

Priority Wastes may be introduced only into the loddby, kiln or afterburner of the incinerator.

(D) The Court may upon application by either party (after notice to the other party), modify the list set out in Subparagraph (B)(1) of this Section, above, by the addition or subtraction of specified wastes or classes of wastes. After a waste or class of wastes has been added to the above list, the concentration of said waste shall be taken into account in calculating the aggregate concentration of wastes for purposes of determining whether any waste mixture is to be considered a Priority Waste. Inclusion of a waste or class of wastes in this list shall not excuse Rollins from complying with more stringent federal or state requirements for the incineration of particular wastes or classes of wastes, and shall not be deemed to authorize incineration of any wastes for which further federal or state approvals are necessary. Specifically, the terms of this Judgment shall not be deemed to authorize the incineration of polychlorinated biphenyls, which compound may only be incinerated at a site approved by EPA pursuant to 40 CFR §761.40.

(E) Rollins shall install sensors which indicate whether there is a flow in each line used to feed waste streams into the incinerator. Rollins shall also install sensors which indicate whether the conveyor belt is feeding drums and/or other bulk material to the incinerator.

(F) Rollins shall install sensors to monitor the temperatures in the hot duct, the kiln exit gas, the loddby (at the point where wastes exit from the loddby) and the target wall of the incinerator at all times that the incinerator is in operation.

(G) Rollins shall install continuous recorders and strip charts to record all of the information required to be monitored by the terms of Paragraphs (E) and (F) of this Section, above. Such continuous recorders shall be subject to the following specifications:

- (1) Each strip chart which contains either an indication of whether there is a flow of wastes to the incinerator through any given feed line, or whether or not the conveyor belt is feeding drums and/or other bulk material to the incinerator shall also contain a continuous recording of the hot duct temperature, so as to enable one examining each such chart to determine the existence of feed of Priority Wastes in relation to incinerator temperature at any given instant.
- (2) The continuous recorder utilized to record the information required by Subparagraph (1), above

shall be operated at a chart speed of at least one inch per 30 minutes.

(3) The chart referred to in Subparagraph (1), above, shall contain either a printed or handwritten designation of the date and the hour for each hour that the incinerator is in operation, so that the date and time for all recordings on the chart can be ascertained.

(4) The chart referred to in Subparagraph (1), above, shall be annotated to show which waste streams being fed to the incinerator contain non-Priority Wastes while the incinerator is operating at a temperature below 1800° F.

(H) Rollins shall install automatic feed shut-off valves on all lines which feed Priority Wastes to the incinerator and an automatic shut-off on the conveyor belt which feeds drums of waste and bulk material to the incinerator. Rollins shall further install mechanisms to cause the shut-off of Priority Wastes streams being fed to the incinerator whenever the temperature in the hot duct of the incinerator falls below 1800° F.

(I) Rollins shall install an automatic audible alarm which will sound whenever Priority Waste streams are being fed to the incinerator and the temperature in the hot duct of the incinerator falls below 1800° F. This alarm shall be audible in the incinerator control room and within a radius of 50 yards from the control room.

(J) At all times that the incinerator is in operation, a Rollins employee shall remain in the incinerator control room. Such employee shall continuously monitor the incineration of wastes, and the temperature at which wastes are incinerated, and shall notify the appropriate person(s) so as to effectuate the requirements of Paragraph (K) of this Section, below. Provided that, should there be no violations of the provisions of this Judgment for a period of one year following installation by Rollins of a programmable control system for its incinerator, then Rollins shall be relieved of the duty to maintain an employee in the incinerator control room at all times.

(K) In the event that the hot duct temperature shall fall below 1800° F during the incineration of Priority Wastes, and any of the automatic feed shut-off valves referred to in Paragraph (H) of this Section shall fail to function properly, then the operator shall manually shut off flow of all Priority Wastes immediately.

(L) Rollins shall analyze the contents of each storage tank of non-Priority Wastes that is to be or may be incinerated at temperatures of less than 1800° F. Records of each analysis required by the terms of this Paragraph shall provide at a minimum the following information:

- (1) the date and time the analysis was performed;
- (2) the name of the person performing the analysis;
- (3) the analytical results which show the tank contents to be non-Priority wastes;

- (4) the date(s) and time(s) at which the contents were incinerated.

(M) Rollins shall maintain an incinerator operating log in which is noted the following information on an hourly basis during all times that the incinerator is in operation:

- (1) the date and time of entry;
- (2) the name of the incinerator operator;
- (3) the numbers assigned by Rollins to the waste blends that were incinerated in the previous hour;
- (4) the storage tank number(s) from which wastes were directed to the incinerator within the previous hour;
- (5) an indication of whether any non-Priority Wastes were incinerated during the previous hour at temperatures below 1800° F, and the times when non-Priority Waste incineration was begun and was ended during that hour;
- (6) the hot duct temperature at the time of the recording;
- (7) the kiln exit gas temperature at the time of recording;
- (8) the loddby temperature at the time of recording;
- (9) the target wall temperature at the time of recording;

- (10) the temperature at which the automatic shut-off referred to in Paragraph (J) of this Section, above, is set.

The operator shall sign or initial the operating log during his tour of duty.

(N) Rollins shall submit a monthly report to EPA by the tenth of each month containing the following information concerning operation of the incinerator during the previous month.

- (1) The original copies of the strip charts for each day during the previous month showing the hot duct, kiln, loddby, and target wall temperatures, and indicating whether there is a flow of wastes to the incinerator, and whether the conveyor belt is feeding drums and/or other bulk material to the incinerator, as required by Paragraph (G) of this Section, above. The original copies of these strip charts shall be returned by EPA to Rollins with 60 days of their receipt. These originals shall then be maintained for a minimum of two years by Rollins. The strip charts required to be compiled by Paragraph (G)(1), above, shall be submitted in color, or shall employ such other method so as to clearly show each individual waste stream.
- (2) Copies of the records of analysis required to be compiled in Paragraph (L) of this Section, above.

- (3) Copies of all incinerator operating logs required to be compiled in Paragraph (M) of this Section, above.
- (4) A report of any instances during the previous month where the automatic feed shut-off valves referred to in Paragraph (H) of this Section, above, or the automatic audible alarm referred to in Paragraph (I) of this Section, above, have failed to function properly, with a brief analysis of the probable reasons for the failure, and an explanation of any steps that were taken to correct the problem.
- (5) A hot duct temperature variance report indicating:
 - (a) the date and time of all instances in the previous month when the hot duct temperature fell below 1800° F during the incineration of Priority Wastes;
 - (b) the name of the shift supervisor on duty during the instances referred to in Subparagraph (a), above;
 - (c) a brief description of the reason, or probable reason, for the temperature drops referred to in Subparagraph (a), above, and;

- (d) a description of the corrective action taken subsequent to the instances referred to in Subparagraph (a), above;

The monthly report required by this Paragraph shall be submitted to:

Chief
Air and Environmental Applications Section
Permits Administration Branch
U.S. Environmental Protection Agency
26 Federal Plaza
New York, New York 10007

(O) Nothing in this Judgment shall relieve Rollins of the responsibility for complying with the requirements of any other regulation, statute, or permit concerning operation of its incinerator, including, but not limited to the provisions of Title 7, Chapter 27, Subchapter II, of the New Jersey Administrative Code, relating to the operation of incinerators, unless specific exemptions are granted to Rollins by the New Jersey Department of Environmental Protection, and (if necessary) approved by EPA. Neither shall Rollins violate any other provisions for the New Jersey Implementation Plan, promulgated pursuant to Section 110 of the Act, 42 U.S.C. §7410. Furthermore, nothing in this Judgment shall relieve Rollins of liability it may have under federal or state law for additional penalties as a result of violations not covered by this Judgment. Rollins acknowledges that it has been notified that it may be subject to penalties under Section 120 of the Act, 42 U.S.C. §7420, but reserves the right to contest the assessment and attempted collection of noncompliance penalties under that section or seek exemption from said noncompliance

penalties. Nothing contained in this Judgment shall be construed to prevent or limit the application of the provisions of Section 303 of the Act, 42 U.S.C. §7603.

IV. EPA shall monitor Rollins' compliance with this Judgment. Upon discovery by EPA of what the Agency believes to be a violation of the terms of this Judgment, EPA shall notify the Court and Rollins in writing. Where the violation is one covered by the penalty provisions of this Section, below, Rollins shall pay by cashier's or certified check payable to the Treasurer, United States of America, the liquidated penalty required by this Section, unless Rollins shall request a hearing on the factual basis for the violation, in which case the Court shall evaluate all evidence and shall decide whether Rollins has violated the terms of this Judgment. The remittance of liquidated penalty or the request for a hearing must be made within fifteen days of Rollins receipt of notification of the violation.

Rollins shall pay the following liquidated penalties in the event of any violation of the requirements of Section III of this Judgment:

(A) Immediately upon the date of the entry of this Judgment on Consent until either eleven months after said entry or four months after the installation by Rollins of a programmable control system for its incinerator, whichever is sooner, the following schedule shall apply:

- (1) Whenever the temperature in the hot duct of Rollins' incinerator falls below 1800° during the incineration of Priority Wastes, should

Rollins fail to shut off the feed of Priority Wastes (either manually or automatically) within five minutes of the time that the hot duct temperature falls below 1800° F, then Rollins shall pay a liquidated penalty of one thousand five hundred dollars (\$1,500.00) for exceeding the initial five-minute period, and one thousand five hundred dollars (\$1,500.00) for each additional five-minute period that the time period is exceeded, up to a maximum of twenty five thousand dollars (\$25,000.00) for any single calendar day of violation. Provided that, should the hot duct temperature, upon falling below 1800° F, remain between 1750° F and 1800° F for less than ten minutes, and then be raised above 1800° F, no penalties shall accrue. Should the hot duct temperature, upon falling below 1800° F, remain between 1750° F and 1800° F for ten minutes or longer, (as described in the preceding sentence) then penalties shall begin to accrue after the initial ten minute period, and shall continue to accrue for as long as the temperature remains below 1800° F.

- (2) Whenever the temperature in the hot duct of the incinerator shall fall below 600° F for more than five minutes during the incineration

of non-Priority Wastes, Rollins shall pay a liquidated penalty of five hundred dollars (\$500.00) for exceeding the initial five-minute period, and five hundred dollars (\$500.00) for each additional five-minute period up to a maximum of twenty five thousand dollars (\$25,000.00) for any single calendar day of violation.

(3) Whenever records are not provided by Rollins for any period during which the incinerator is operating, Rollins shall pay liquidated penalties as indicated below:

(a) during incineration of Priority Wastes, hot duct temperature is not provided - a penalty of one thousand five hundred dollars (\$1,500.00) shall accrue if the information is not provided for an initial period of five minutes, and an additional penalty of one thousand five hundred dollars (\$1,500.00) shall accrue for each additional five-minute period for which the information is not provided, up to a maximum of twenty five thousand dollars (\$25,000.00) for any single calendar day of violation;

(b) during incineration of Priority Wastes, when the hot duct temperature falls below

1800° F, an indication of the stoppage of Priority Waste feed (through feed lines and/or by way of conveyor belt) is not provided - penalty as provided in Subparagraph (a), above, up to a maximum of twenty five thousand dollars (\$25,000.00) for any single calendar day of violation;

(c) during the incineration of non-Priority Wastes, hot duct temperature is not provided - a penalty of five hundred dollars (\$500.00) shall accrue if the information is not provided for an initial period of five minutes, and an additional penalty of five hundred dollars (\$500.00) shall accrue for each additional five-minute period for which the information is not provided, up to a maximum of twenty five thousand dollars (\$25,000.00) for any single calendar day of violation;

Provided that, should the strip chart referred to in Paragraph (G), of Section III, above, fail to function at any time because of a mechanical problem, Rollins may provide for the manual recording, at fifteen-minute intervals, of all information required by Subparagraph (N)(1), of Section III, above, for a period of not more than forty-eight hours, without the accrual of penal-

ties cited in this Subparagraph (3). Provided also that, should any failure of the strip chart occur during the incineration of Priority Wastes while the temperature is below 600° F, then the penalties provided by this Subparagraph shall accrue whether or not manual recordings are made.

No penalties or combination of penalties provided for under this Paragraph shall accumulate to more than twenty five thousand dollars (\$25,000.00) for any single calendar day of violation.

(B) Commencing either eleven months after the entry of this Judgment, or four months after the installation by Rollins of a programmalbe control system for its incinerator, whichever is sooner, the following schedule shall apply:

- (1) Whenever the temperature in the hot duct of Rollins' incinerator falls below 1800° F during the incineration of Priority Wastes, should Rollins fail to shut off the feed of Priority Wastes (either manually or automatically) within three minutes of the time that the hot duct temperature falls below 1800° F, then Rollins shall pay a liquidated penalty of one thousand five hundred dollars (\$1,500.00) for exceeding the initial three-minute period, and one thousand five hundred dollars (\$1,500.00) for each additional three-minute period that the time period is exceeded, up to a maximum of

twenty-five thousand dollars (\$25,000.00) for any single calendar day of violation.

- (2) Whenever the temperature in the hot duct of the incinerator shall fall below 600° F for more than three minutes during the incineration of non-Priority Wastes, Rollins shall pay a liquidated penalty of five hundred dollars (\$500.00) for exceeding the initial three-minute period that the time period is exceeded, up to a maximum of twenty five thousand dollars (\$25,000.00) for any single calendar day of violation.
- (3) Whenever records are not provided by Rollins for any period during which the incinerator is operating, Rollins shall pay liquidated penalties as indicated below:
 - (a) during incineration of Priority Wastes, hot duct temperature is not provided - a penalty of one thousand five hundred dollars (\$1,500.00) shall accrue if the information is not provided for an initial period of three minutes, and an additional penalty of one thousand five hundred dollars (\$1,500.00) shall accrue for each additional three-minute period for which the information is not provided, up to a maximum of twenty five thousand dollars

(\$25,000.00) for any single calendar day of violation;

- (b) during incineration of Priority Wastes, when the hot duct temperature falls below 1800° F, an indication of the stoppage of Priority Waste feed (through feed line and/or by way of conveyor belt) is not provided - penalty as provided in Subparagraph (a), above, up to a maximum of twenty five thousand dollars (\$25,000.00) for any single calendar day of violation;
- (c) during the incineration of non-Priority Wastes, hot duct temperature is not provided - a penalty of five hundred dollars (\$500.00) shall accrue if the information is not provided for an initial period of three minutes, and an additional penalty of five hundred dollars (\$500.00) shall accrue for each additional three-minute period for which the information is not provided, up to a maximum of twenty five thousand dollars (\$25,000.00) for any single calendar day of violation.

Provided that, should the strip chart referred to in Paragraph (G), of Section III, above, fail to function at any time because of a mechanical problem, Rollins may provide for the manual

recording, at fifteen-minute intervals, of all information required by Subparagraph (N)(1), of Section III, above, for a period of no more than forty-eight hours, without the accrual of penalties cited in this Subparagraph (3). Provided also that, should any failure of the strip chart occur during the incineration of Priority Wastes while the hot duct temperature is below 1800° F, or during the incineration of non-Priority Wastes while the temperature is below 600° F, then the penalties provided by this Subparagraph shall accrue whether or not manual recordings are made.

No penalties or combination of penalties provided for under this Paragraph shall accumulate to more than twenty five thousand dollars (\$25,000.00) for any single calendar day of violation. Penalties for other violations of the provisions of this Judgment shall be at the discretion of this Court.

V. The provisions of this Judgment shall apply to and be binding upon Rollins, as well as its successors and assignees.

VI. Jurisdiction is retained by this Court for the purpose of enabling either party to apply to the Court at any time for such further orders and directions as may be necessary or appropriate for the construction and effectuation of this Judgment, for the modification or termination of this Judgment or any of its terms, or for the punishment of violations thereof.

VII. The provisions of Section IV, above, of this Judgment, and those provisions of Section III of this Judgment, above, which do not relate to the installation of equipment by Rollins, shall terminate at the time (if ever) that Rollins is issued a final administrative permit (not interim status) for the operation of its incinerator, pursuant to Section 3005 (c) of the Resource Conservation and Recovery Act, 42 U.S.C. §6925(c). All other provisions of this Judgment shall remain in effect until and unless expressly terminated by this Court.

VIII. Each party shall bear its costs in this matter.

Dated: _____, _____, New Jersey

UNITED STATES DISTRICT JUDGE

The undersigned hereby consent to the entry of the foregoing Judgment without further notice.

JAMES W. MORRMAN, Esq.
Assistant Attorney General
Land and Natural Resources Div.
U.S. Department of Justice

ROBERT J. DEL TUFO
United States Attorney for the
District of New Jersey

By: _____

Assistant U.S. Attorney

ROLLINS ENVIRONMENTAL SERVICES
(NJ) INC.

By: _____
Robert C. Gregory,
Vice President